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F. Hedges

Bact. phas. – p. 341
" flacc. – p. 349

Lima bean
1. {premature ripening & drying of pods. p. 357
2 seed stain – p. 357

THE PLANT DISEASE BULLETIN

Issued By

THE PLANT DISEASE SURVEY

Supplement 22

Diseases of Field and Vegetable Crops in the United States in 1921

July 20, 1922

BUREAU OF PLANT INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE

DISEASES OF FIELD AND VEGETABLE CROPS IN THE UNITED STATES

IN 1921*

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Plant Disease Survey

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* Summaries of diseases of field and vegetable crops in the United States for the years 1918, 1919, and 1920 have been given in U. S. Dept. Agr. Plant Dis. Bul. Supplement 2: 42-83. 1919; 3: 84-118. 1919; 10: 180-273. 1920; 16: 177-287. 1921.

+ Temporary appointment while on leave of absence from the Michigan Agricultural Experiment Station.

INTRODUCTORY STATEMENT

The collaborators of the Plant Disease Survey, about 150 in number and located for the most part at the various state agricultural experiment stations, have supplied the information that has been used as a basis for this summary. In addition to the collaborators, other plant disease experts, in federal, state, and private work, have contributed many valuable notes. The pathologists of the Bureau of Plant Industry have been especially helpful in this respect. Reports of the market inspections made by the United States Division of Markets, Bureau of Agricultural Economics, have been used, and most of the American publications on the subject of diseases of vegetables that have appeared during the past year have been consulted and the references given.

Since the compiler has merely brought together the contributions from the various sources, it is preferred that writers when citing portions of this summary give credit to the original contributor rather than to the summarizer whenever possible.

Data on losses from vegetable diseases have been given freely throughout the following pages. Revised and complete estimates of losses for the diseases of potato, sweet potato, tomato, bean, and cotton are being worked out and will appear in the Plant Disease Bulletin Supplement 24 entitled "Crop losses from plant diseases in the United States in 1921". For final loss estimates on the above mentioned crops writers should consult that supplement.

Particular attention has been given in the following summary to the relation of weather to diseases and some correlations, between the influence of weather and distribution and severity, have been made. Readers are referred to the rather complete account in the Plant Disease Bulletin Supplement 20, "Diseases of fruit and nut crops in the United States in 1921", for a summary of general weather conditions in 1921.

As is shown in the table of contents, the information has been summarized by crops and by crop groups, some of our more important crops being given first and the less important ones arranged alphabetically at the end. Since the control of potato diseases is accomplished largely by the practice of a few important measures, it has seemed best to summarize the results obtained in this field during the past year under separate headings, namely; seed certification, seed treatment, spraying, and dusting. A discussion of the individual diseases of potatoes and the other crops is then taken up in the remainder of the summary.

POTATO

Seed certification

The outstanding feature of potato work in the United States and Canada during the last few years is the remarkable extension of the potato certification movement. This work, in close touch with extension and investigational agencies in the States and Canada, is partially meeting the situation brought about by the progressive deterioration of potato varieties by disease.

It may be said that varietal standardization has already been accomplished so far as standard types are concerned, but the potato certification work has not as yet advanced to the point where it deals with pure lines of high productive power.

It is necessary that standards be raised and that inspections in the various states be uniform and consistent. Undoubtedly, the time is ripe for a field conference of workers and men in charge of inspection work, but such conference, to be most successful, must needs come during the height of the inspection season. It is to be hoped that the summer conference of the Phytopathological Society in August 1922 may serve to bring about greater standardization of practice and conformance to the best standards of excellence.

The following extract from a letter by the United States Department of Agriculture, Office of Cotton, Truck, and Forage Crop Disease Investigation, to workers interested in potato seed improvement, throws light on some of the seed potato problems that must be met by inspection and certification.

> "It has not been so easy to control leaf-roll and mosaic as might be wished. Recent reports indicate that a good deal of certified stock sent out from fields in the North to southern points has developed a large percentage of leaf-roll or mosaic. For example, at the Experiment Substation at Onley, Virginia, this season, one plot of Irish Cobblers grown from northern certified seed showed 42% leaf-roll as well as some mosaic and other degeneration troubles, such as dwarfing, upward growth, etc.; another plot of the same variety from northern certified seed showed 7% leaf-roll. At Alexandria, Louisiana, in April 1921, fields planted with northern certified Triumph seed stock showed between 70 and 80% of mosaic infested plants. In June 1920, a 200-acre potato field near Charleston, South Carolina, planted with northern certified Irish Cobblers showed leaf-roll or mosaic (accompanied by curly dwarf and spindle sprout) affecting 90% of the hills."

Nearly all states report an increase in the number of acres inspected and with the more favorable yield of 1921 this has meant a heavy increase in bushels of certified potatoes available for use. The significance of this body of high grade seed stock in reducing losses is apparent.

Another noteworthy thing is the report on premium paid for certified stock. In other years when the premium was approximately 25¢ a bushel, the growing of certified seed stock was a good practical proposition, not alone for the slight margin over market price, but because of the greater sureness of a market. The prices reached with the 1920 crop and again with the 1921 crop are such as to insure repayment for the time, trouble, and extra expense of producing certified seed, and this premium seems necessary if the matter of production of certified seed is to be permanent. The producer of good seed potatoes deserves a legitimate profit.

Table 31. Summary of potato seed certification in the United States and Canada in 1920 and 1921. (Summarized by A. G. Tolaas.)

Place	Agency handling inspection	Year	Applications	Acreage	Certified			Difference in: price per cwt. above ordinary stock	Varieties certified	No. of inspections
					No. of fields	Acreage	Bushels			
Me.	E.L.Newdick, State Dept. of Agr., Augusta	1920	76	577	42	462	130,000	60¢	Green Mountain Irish Cobbler Spaulding Rose	3
		1921	118	1,315		608	217,360	60-70¢	Same as 1920 and Mills Pride	
N. J.	H. B. Weiss & M.T.Cook, Plant Pathologist, State Dept.Agr.	1920	31	197		158			Irish Cobbler, American Giant Mills Pride N. J. Red Skin	1
	E. West, State Dept.Agr.& N.J. Potato Growers Assoc.,Trenton	1921	85	907.75		573.5			Same as 1920	
N. Y. (a)	E.V.Hardenburg, Potato Growers Assn. and Dept. Plant Path.Col. Agr., Ithaca	1920	195	1,270	196	766	189,242	75¢	Green Mountain Smooth and Russet Rural New Yorkers American Giant Irish Cobbler	3
	M.F.Barrus, Dept. Plant Path. & J.M.Hurley, N.Y. Cooperative Seed Potato Assn., Syracuse	1921	177	1,210	200	773	172,146	$1.20-1.65	Green Mt., Norcross No. 9, Sir Walter Raleigh, Dibbles Russet, Russet Rural Amer. Giant, Irish Cobbler, Mill Prize, Heavyweight	
(b)	Same service to 9 Farm Bureaus	1920	87	300		209	45,203			
		1921	76	348		283	47,769			

Place	Agency handling inspection	Year	Appli-cations	Acreage	Certified			Difference in: price per cwt. above ordinary stock	Varieties certified	No. of inspections
					No. of fields	Acreage	Bushels			
Pa.	R. E. Hartman, State Dept. Agr. Harrisburg	1920			12		25,000	50¢	Rural New Yorker Russet Rural New Yorker	3
	Same as above	1921		400	23	68	24,875	80¢-$1.20	Russet Rural Spaulding Rose	
Vt.	A. H. Gilbert, State Dept. Agr.	1920	206	550	90	282	3,450	Avg. $1.00	Green Mountain Irish Cobbler	2
	Burlington	1921	203	782	130	480	100,000	75¢-$1.50	Same as 1920	
Mich.	H.C.Moore, Mich. Potato Producers	1920	60	269	42	192	26,000	80¢-$2.00	Russet Rural Green Mountain	3
	Assn. and Mich. Agr. College, East Lansing	1921	146	1,030	98	660	97,000	80¢-$2.00	Same as 1920 and White Rural Irish Cobbler	
Minn.	A.G.Tolaas, Minn. Board for Seed Potato Inspection & Certification, Uni.	1920	610	4,241	345	2,421	317,975	25¢-$1.00	Early Ohio, Green Mt., Irish Cobbler, Burbank Russet, King, Rural New Yorker, Bliss Triumph	3
	Farm, St. Paul	1921	504	4,582.5	381	3,783	605,280	35-75¢	Same as 1920	
Wis.	J. G. Milward, Hort. Dept., Col. of Agr., Madison	1920	255	1,735	137	1,075	194,000	50-75¢	Rural New Yorker Green Mountain, Bliss Triumph, Early Ohio, Irish Cobbler	2*
		1921	---	---	---	---	--- ---	--		
Nebr.	H. O. Werner, Agr. Ext. Service	1920	35	660	17	251	21,770	75¢-$2.00	Bliss Triumph Early Ohio	2
	Lincoln	1921	62	1,085	29	656	44,885	$1.00-1.60	Same as 1920	

Place	Agency handling inspection	Year	Applications	Acreage	Certified			Difference in: price per cwt. above ordinary stock	Varieties certified	No. of inspections
					No. of fields	Acreage	Bushels			
Colo.	E. P. Sandsten, State Horticulturist, Ft. Collins	1920	200	1,000	40			$1.00-1.50	IrishCob., Bliss Tri. Pearl, Brown Beauty Russet Rural N. Y.	2
		1921	---	---	--			----		
Ida.	E.R.Bennett, Agr. Ext.Div.Uni.Ida. Boise	1920	145	620	20	129	3,500	50-150%	Netted Gem Idaho Rural	3
		1921	---	---	--	---	- ---	----		
Calif.	W.V.Shear, State Dept. of Agr. Sacramento	1920	18	514	25	424	26,000	$1.00-2.00	British Queen, White Rose, Burbank, Amer. Wonder, Red Prizetaker	3
	Same as 1920	1921	27	803	25	438	90,000	50% increase	Same and Gt.Divide	
Ore.	W. S. Carpenter Agr.Col.Corvallis	1920	130	494	12	43	4,710	75¢-$1.00	Netted Gem, Burbank Early Rose	3
	G.R.Hyslop, Agr. Col., Corvallis	1921	288	1,355		387		75¢	Netted Gem, Earliest of All, Early Rose	
Wash.	J. E. Currey, State Dept. Agr. Olympia	1920	37	238	28	206	14,700	50-100%	Netted Gem, Burbank, American Wonder	4
		1921	105	572	85	447	23,530	50%	Netted Gem, Burbank, Idaho Rural, Early Ohio, Amer. Wonder	
Canada	Geo. Partridge, Div. Bot., Dept. of Agr., Ottawa	1920	1,274	7,613		3,956	234,552	40¢	Green Mt., Garnett Chili, Irish Cobbler, Early Ohio, Rural New Yorker	**
	Same as 1920	1921	1,349	7,900	1,634	4,328	293,838 incomplete	40-60¢	Same as first 4 above with Dooley, American Wonder, Empire State	

*Field and bin inspections.

**Field, bin, and shipping inspections.

It will be noted that in Table 31 forty-two varieties of potatoes are listed. It is worthy of note that so many varieties are being certified. Many of these are synonyms and some are "trade names". It will be a step in advance when this list of names is strongly cut and some system of variety naming is adopted to permit better understanding.

The potato certification agencies have never done enough follow-up work with their products to secure the telling figures showing the superiority of certified over common seed. The following statements and figures from various states deserve record:

New York: The yields of the inspected fields were twice as high as the average for the state. (Barrus).

Michigan: Special efforts to test Michigan-grown seed in other states were made in 1921. Seven-hundred-thirty seven hundred-pound sacks were used in the tests in five states and the following records were secured:

Table 32. Results of tests of Michigan certified seed made in various states in 1921. (H. C. Moore).

State	No. of 100#: sacks furnished	No. of records secured	Average increased yield per acre over home-grown seed produced by Michigan certified seed.
Pa.	390	75	62.5 bushels
Ohio	15	6	2.6* "
Ind.	85	21	63.0 "
Ill.	220	61	44.0 "
Iowa	27	6	61.2 "

*Compared with New York Certified Rurals.

Minnesota: The demonstrations were tried in 1921 in approximately 50 of the counties of Iowa. Owing to the extreme weather conditions which prevailed, the results are more or less inconclusive. The year before Professor Fitch of the Iowa Station carried on similar demonstrations on a smaller scale and reported very good results in favor of the certified product. (A. G. Tolaas).

Colorado: Tests made by the writer at Eagle during the past season indicate that certified seed yields more potatoes to the acre and the quality and vigor are better. (C. M. Tompkins).

Recent literature

Gilbert, Alfred H. Certified seed inspection in Vermont. Potato Mag. 3^7: 6, 20-21, 26. 1921.
Hardenburg, E. V. Seed potato problems. Potato Mag. 3^{10}: 22-23, 25, 30. 1921.
Tolaas, A. G. Seed certification makes great progress. Potato Mag. 3^{12}: 9-11, 25. 1921.

Seed treatment

The hot formaldehyde method of Melhus has continued in favor in several states. Blodgett and Perry[1] tell of 9,000 bushels being treated by this method. From this test it was found that the addition of .9 of a pint of formaldehyde per 50 bushels treated would maintain the desired concentration of formaldehyde (3.6 gms. per liter).

The following statement and tables concerning results of seed treatment in New York have been furnished by the collaborators of that state. (See potato scab for comments from other states.)

Table 33. Results of potato seed treated with hot formaldehyde in New York State during 1921. (Barrus and Chupp).

County	Number of tests	Length of treatment	Yield in bushels Treated	Untreated	Gain or loss
Allegany	2	2 minutes	217.8	197.4	+20.4
Genesee	1*	-	257.3	260.2	- 2.9

* Ten replications.

Table 34. Results of potato seed treated with mercuric chloride in New York State during 1921. (Barrus and Chupp).

County	Number of tests	Length of treatment	Yield in bushels Treated	Untreated	Gain or loss
Allegany	1	1.5 hours	268.0	246.6	+21.4
Chemung	5	1.5 "	189.2	154.2	+35.0
Cortland	1	1.5 "	160.0	140.0	+20.0
Erie	1	1.25 "	170.0	170.0	0.0
"	1	1.25 "	307.0	279.0	+28.0
"	1	1.5 "	236.0	268.0	-32.0
"	18	1.5 "	158.8	127.9	+30.9
Genesee	1*	.5 "	219.8	260.2	-40.4
"	1*	1.5 "	225.6	260.2	-34.6
Livingston	2	-	190.0	126.0	+64.0
"	1	-	224.0	259.0	-35.0
Onondaga	3	1.5 hours	164.5	150.6	+13.9
Orleans	3	1.5 "	140.6	126.1	+14.5
Total....	39	Averages.......	177.2	154.8	+22.4

* Ten replications.

"One cannot draw conclusions in regard to the value of potato seed treatment from the results of a few tests in one county. But if a large number of tests are included, not only from different counties but also during a series of years, and each report consistently points to appreciable gains in yield, the accumulation of benefits should bear considerable weight. In the table are listed the gains for four consecutive seasons. It will be observed that during 1918 and 1921 the increased yields were not so pronounced. The weather during these seasons was hot and dry, so that conditions generally were unfavorable for potato production. Even then the gains were sufficient to more than pay for the cost of treating. Each field which showed a decreased yield is listed separately, so that it stands out prominently, showing that occasionally, due to one or more of numerous possible reasons, the yields are decreased. Where data are available in such cases, however, the increased smoothness of tubers and uniformity in size usually are sufficient to offset any decrease in yield." (Barrus and Chupp).

Table 35. Summary of results of all potato seed treatments in New York State. (Barrus and Chupp).

Year	Number of		Average yield in bushels		Average gain or loss
	Counties	Tests	Treated	Untreated	
1921	8	42	181.0	159.4	+21.6
1920	8	38	277.0	244.9	+33.0
1919	7	28	237.0	189.0	+48.0
1918	4	49	201.0	187.0	+14.0

Total number of tests 157 Average gain............... +30.1

Recent literature

Cited

1. Blodgett, F. M. and F. R. Perry. Additions of formalin to maintain the concentration uniform with direct steam heat in the hot formaldehyde treatment of potatoes. Phytopath. (Abstract) 12: 39. Jan. 1922.

Not cited

Porter, R. H. A two-minute treatment of seed potatoes. Potato Mag. 3^{9}: 8-9. 2 fig. 1921.

Spraying

The following statements and figures with reference to spraying for leaf diseases have come to the Office of the Plant Disease Survey during the past year:

New York:

Table 36. Results of potato spraying in New York previous to 1921. (Barrus and Chupp).

Year	Number of		Was blight present	Average yield per acre of		Average gain or loss
	Counties	Tests		Sprayed	Check	
1920	11	57	Yes	277.0	206.0	+71.0
1919	4	14	Yes	339.0	274.5	+54.5
1918	7	28	No	173.6	141.1	+32.5
Average gain for three year period, 1918-1920........						+49.3

Table 37. Results of potato spraying in New York during 1921. (Barrus and Chupp).

County	No. of tests	Fungicide used	No. of applications	Was blight present	Total cost	Yield per acre Sprayed	Yield per acre Check	Gain or loss
Erie	1	6-8-60	5	No	$ 4.58*	199.0	172.0	+27.0
Washington	2	4-4-50=1 6-6-50=7	8	No	18.00	280.0	239.5	+40.5
	1	4-4-50=1 6-6-50=7	8	No	18.00	153.0	163.0	-10.0
Orleans	3	6-6-50 5-5-50 5-8-50	2 5 4	No	6.54	130.4	111.9	+18.5
Steuben	1	Replicated 144 times	8	No	- --	244.0	198.0	+46.0
Onondaga	14	4-4-50=3 5-5-50=2	4 or 5	No	10.50	200.8	153.3	+47.5
Total tests	22							
Averages			5	No	10.72	198.1	158.8	+39.3

*Plus labor

Spraying did not give as big an increase in yield during the hot dry seasons of 1918 and 1921 as it did in the cooler and more humid seasons of 1919 and 1920. In the latter seasons the potatoes naturally yielded higher, and also because much blight was present, the difference between sprayed and unsprayed was very marked.

West Virginia:

Table 38. Results of spraying tests in West Virginia as reported by Giddings.

Variety	Place	No. of applications	Dates	Results	Remarks
Irish Cobbler	Wheeling	4	5-27,6-6 6-20,6-30	25% gain	Practically free from all diseases except tip-burn
Common	Parkersburg	3	6-12,6-16 6-27	20% gain	Tip-burn severe
An early variety	Parkersburg	4	5-21, 6-2 6-16,6-27	No gain	Tip-burn severe
An early variety	Fairmont	5	5-14,5-26 6-4,6-17, 7-1	33 1/3% gain	

Variety	Place	No. of applications	Dates	Results	Remarks
Not stated	Davis	3	Not given	37.5% gain	Very little late blight
Not stated	Davis	3	Not given	29.4% gain	Very little late blight

Ohio: Forty-seven Ohio potato growers in 9 counties during 1921 made 60 tests on one-half acres or more of potatoes. Thirty-four of these growers left check rows unsprayed, and 31 of these received a profit. From 4 of the 60 tests, insufficient increases were received to offset the cost of spraying. The average increase for all tests was 31 bushels per acre. Hopperburn (tipburn) of the leaves was the main potato trouble against which control was secured. This disease is caused by leafhoppers which enter the fields in midsummer. Bordeaux mixture, 5-5-50, was used. Besides being a fungicide, this is known to repel the leafhoppers. During the growing season, 3-4-5-and 6 applications were made at two weeks' intervals. Four applications of spray gave the highest net gain ($55.70 per acre). From 75 to 90 gallons per acre per spray were found to be advisable. Power, traction, and hand-pump outfits were all used in these tests. Power sprayers gave better results than traction outfits. All sprayers, with one exception, were equipped with three nozzles per row. Two nozzles were directed up and one down, an effort being made to cover both sides of the leaves. Results indicate that 3 nozzles per row are absolutely essential for effective spraying. Rods equipped with 3 nozzles per row and operated by hand gave the most thorough covering of foliage. Extra labor required increases the cost of this method of spraying. (Parks and Clayton[1]).

Table 39. How spraying potatoes with Bordeaux mixture paid in Ohio in 1921. (Parks and Clayton).

No. of sprays	All types machines			Traction sprayers			Power sprayers		
	No. of tests	Increase in bu. per acre	Net gain per A.	No. of tests	Increase in bu. per acre	Net gain per A.	No. of tests	Increase in bu. per acre	Net gain per A.
3	24	20.9	$23.85	14	16.0	$16.50	9	28.9	$35.85
4	10	43.8	55.70	3	33.5	40.25	5	47.6	61.40
5	14	40.4	48.30	-	-- -	-- --	12	43.2	52.35
6	8	33.2	34.87	8	33.2	34.87	-	-- -	-- --

England: The following results of English tests are of interest[2]: "Spraying has increased total yield of all plots in the nine years' average."

Table 40. Nine years' average of results of spraying tests, for the control of late blight, conducted in England.

	Not sprayed	Sprayed once, early	Sprayed once, late	Sprayed twice, early and late
	Cwt.	Cwt.	Cwt.	Cwt.
Ware#	90.40	105.69	108.65	115.23
Seed	28.82	32.09	30.82	31.41
Chats*	18.49	17.48	17.89	16.79
Diseased	8.00	8.92	6.61	6.97
Total	145.75	164.00	164.00	170.50

# Ware - marketable. *Chats - small potatoes.

Literature cited

1. Parks, T. H. and E. E. Clayton. Does spraying potatoes with Bordeaux pay? Ohio State Univ. Ext. Leaflet. 1921.
2. Pennington, S. and H. G. Robinson. Spraying of potatoes for blight or potato disease, (Phytophthora infestans). Bul. Univ. Col. Reading 30: 9. June 1921.

Dusting

A number of collaborators have furnished reports, which are given below, regarding the use of dusts for the control of leaf diseases of the potato:

New York: Last year, Professor Whetzel in his conclusions on the results of potato dusting work said that more carefully planned and more extensive tests must be made before the question of the relative values of dusting and spraying is finally decided. Such tests were conducted this year but the question is not yet answered. It may require several years of experimental work before it can be answered.in a satisfactory manner.

Weather conditions were not favorable for the development of late blight in most parts of the state. As a result late blight was not a factor in these experiments with the exception of those on Long Island where this disease was of considerable importance. In all the previous recorded experiments with Bordeaux mixture, the most significant increases in yields due to spraying have been obtained when late blight has been a factor of importance, while during non-blight years the increases from spraying have been only normal and on the average sufficient only to pay for the cost of application. Copper-lime dust is a substitute for Bordeaux mixture spray and the most significant results from its use would seem to come when blight is an important factor.

It will be noticed from the average yields of each experiment that there is a consistent increase in yield of the dusted rows over the checks. In only one case was there a decrease, this being where potatoes, planted in muck, died early in the season before the advantages of the application could overcome the injury caused by the use of the dusting machine. In a majority of the experiments where a power duster was used the increases are significant and indicate, even in the absence of blight, a beneficial effect from the dust. The increases, however, are somewhat smaller than those obtained from the Bordeaux spray, except in one experiment.

From the experiments we must conclude that copper lime dusts under the conditions applied this year afforded protection to the vines as indicated by the increase in yield over vines not dusted, that they afforded ample protection against late blight, but that the protection through the application of these materials by power and traction machines against such injuries as tip-burn, hopper-burn, and those caused by flea beetles was not as great as that afforded by Bordeaux mixture applied with a good traction sprayer. It is apparent that the power duster was more efficient than the traction duster and that dusting with a hand machine gave the best results in yield due, probably, to better distribution of material and to absence of machine injury to the plants. (M. F. Barrus. Potato dusting experiments in New York during 1921. (For complete account of tests write Department of Plant Pathology, Cornell University).

Pennsylvania:

Table 41. Results obtained in Pennsylvania on dusting potatoes, 1921.

Application	Yield per acre, bushels			
	Adams County No. 1	Adams County No. 2	Lehigh County	Schuylkill County
Bordeaux 4-4-50	208.5	198.2	208.5	Increase of sprayed
Copper dust	210.0	187.2	172.5	over dust, 40 bu.
Check	177.0	139.6	168.7	Yields not given

The data for Adams County were supplied by R. C. Walton.
Those for Lehigh and Schuylkill Counties were supplied by E.L.Nixon.

Ohio: Fourteen tests with Bordeaux dust and other potato dusting mixtures gave results greatly inferior to those secured by spraying. (Parks and Clayton).

Michigan: Some control of leaf hopper by both Bordeaux spray and copper lime dust. Early blight, late attack, not controlled. In general, results favorable with dust, given proper timing of applications. (J. E. Kotila).

Wisconsin: Dusting experiments were conducted with potatoes at this station using both powdered Bordeaux and uncombined Bordeaux or monohydrated copper sulphate and lime. When foliage was thoroughly dusted on the under side it appeared these two dusts repelled the potato leaf hopper and controlled hopper burn fully as well as when liquid Bordeaux was used. The season of 1921 was very dry, however, permitting the dusts to remain thick on the foliage much longer than the ordinary season. With an arbitrary standard of three or four applications of dust and spray, I doubt whether Bordeaux dust would give the protection against hopper burn which is possible with liquid Bordeaux. I do not consider last season's results conclusive. (John E. Dudley, Jr.).

Minnesota: Inconclusive. (Leach).

Iowa: We tried out on a very small scale, dusting of potatoes for the leaf hopper with powdered Bordeaux mixture, but it was entirely ineffective. (F. A. Fenton).

Diseases

Late blight caused by *Phytophthora infestans* (Mont.) De Bary

The year 1921 may be considered as a year in which a late blight epidemic was averted by the general high temperatures and drouth prevailing in the early half of the growing season. Nineteen-twenty was considered the worst blight year for the late potato states since 1915. Accordingly, late blight was expected to be rather serious when first reported, but climatic conditions operated to check the spread from primary sources.

Distribution and importance of late blight in 1921

Late blight in 1921 was reported from Maine, New Hampshire, Vermont, Massachusetts, New York, Pennsylvania, Maryland, West Virginia, North Carolina, Michigan, Wisconsin, South Dakota, and Washington; and, according to Colin G.

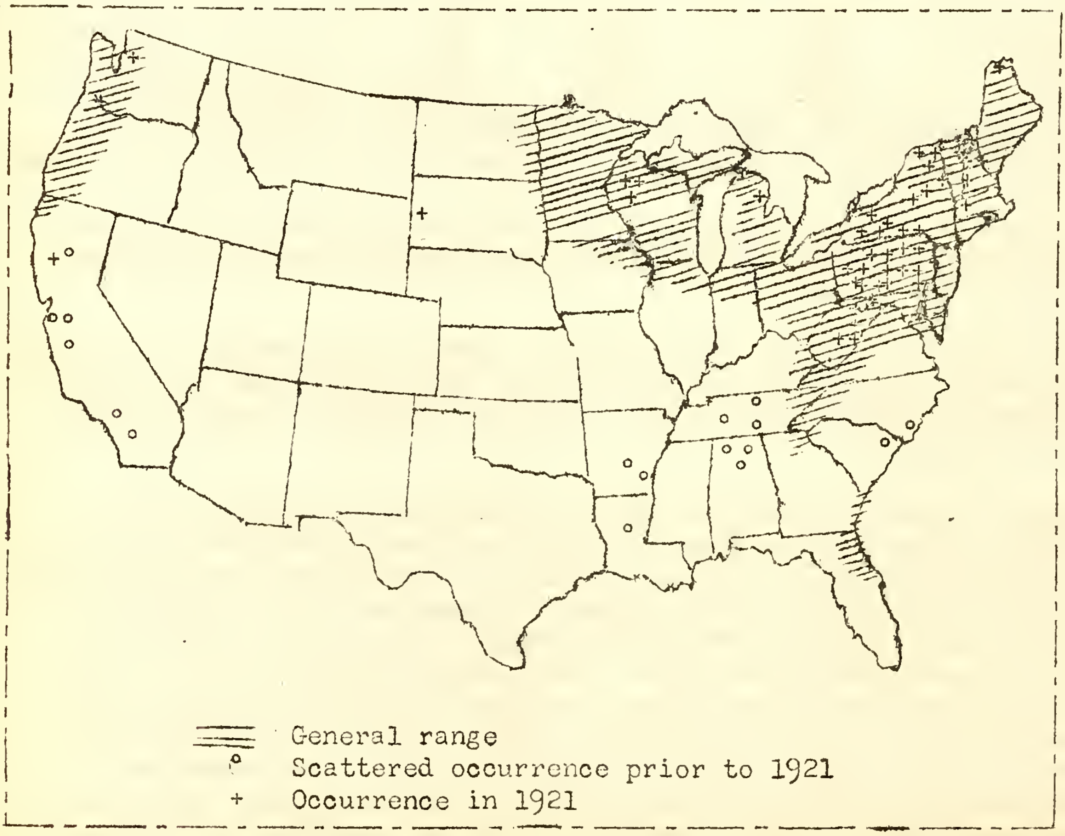

Fig. 64. Approximate known range of *Phytophthora infestans*, and occurrence record for 1921.

Welles[1], it occurred in the Philippine Islands at Trinidad, Mountain Province. In all states except Pennsylvania and a portion of West Virginia blight was of minor importance in its effect on the foliage. With the scattering infection considerable loss from tuber rot in some shipments has been reported by market reporters from Maine and New York.

The range in 1921 again shows the strong influence of July rainfall (Figs. 64 and 65), the areas in nearly every case coinciding closely with the rainfall map for July. (cf. Coons, G. H. Michigan potato diseases. Michigan Agr. Exp. Sta. Spec. Bul. 85: 5-49. Illus. 1918). (Rainfall maps for August and September are given under discussion of early blight distribution).

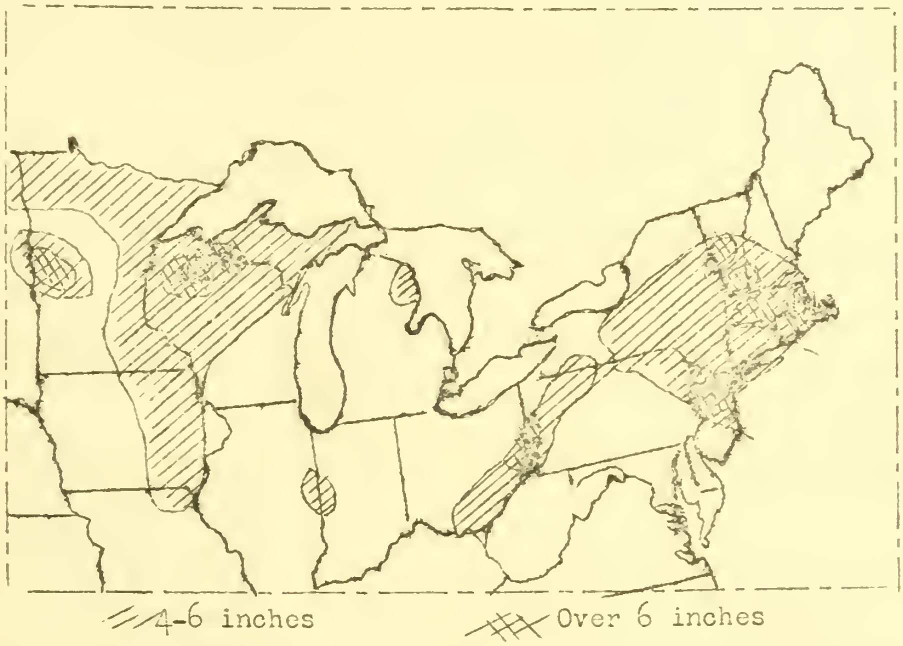

Fig. 65. Total precipitation for July 1921. (Adapted from Nat. Weather and Crop Bul., series 1921^{33}: 7. Aug. 17,1921.)

Some of the more significant reports of the collaborators and others concerning late blight are given below:

Maine:(Aroostock County): There is not any late blight of economic importance. Undoubtedly, Aroostock County has been much more favored with rain than any other part of the state, and the record is as follows: May 1.63 inches, June 1.58 inches, July 2.49 inches, and August 5.43 inches. If the previous three months had been wet, the August rainfall would mean something, but lack of rain in May, June, and July, in my opinion, put late blight out of business so far as doing any damage in Maine is concerned... (W. J. Morse, September 10).

Late blight is really here (Aroostock), but so slight that it would be overlooked by almost any one but a trained observer. It will not be a factor in yield, but may result in an occasional rotted tuber, particularly if the digging has to be done under wet conditions...... However, a frost that may come at any time now, would largely, if not entirely eliminate danger from rot.(Morse, September 13).

New Hampshire: Late blight has been very scarce and we will have very little tuber rot. We have had a very dry summer and have seen the disease only once in an unsprayed field (September 14), and while it was well distributed, the damage done was negligible. (Butler).

Vermont: In the Connecticut River Valley, near Brattleboro, there has been a general infection of several fields. In Orange County, light infections in only one or two fields. These latter seemed to originate at the time of rains, but dry weather coming on the blight was checked...... In the Brattleboro case, I believe that the infection has been brought on by the heavy mists which have been prevalent there recently. (Gilbert).

Very little, perhaps 1%. (Lutman).

Rhode Island: Not of serious importance. (Browning).

Connecticut: I have not seen a single specimen of this fungus on potatoes here this year. (Clinton).

New York: Of little importance this year, a trace in most counties. Too dry and hot for the fungus. (Chupp - See Table 43 showing results of field inspections, page 272).

Pennsylvania: Important locally in high altitudes, reducing the yield for the state 5 to 10%. One hundred percent found in one field. Mostly in the mountainous section, none in the southeastern part. The following reports by counties may be made: Fayette, 30%; Somerset, 25%; Susquehanna, 30%. (Thurston and Orton).

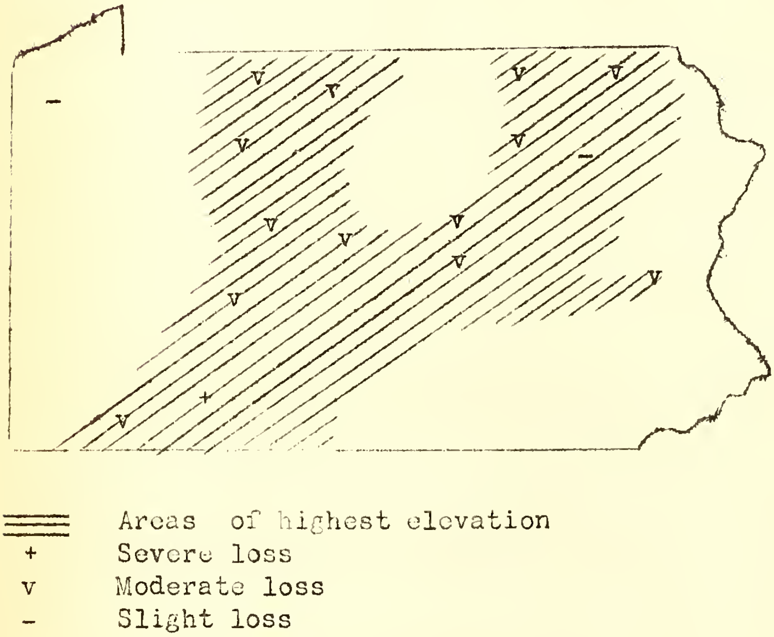

Fig. 66. Late blight distribution in Pennsylvania, 1921, showing relation to mountainous areas.

Maryland: Less prevalent than usual. (Temple and Jehle).

West Virginia: Local in high altitudes in Randolph and Tucker Counties. Mr. Sherwood found late blight at Beverly in Randolph County. The same seed was used for three other patches and blight was very prevalent in all fields planted with that seed. He considers this condition due to the planting of infected seed as adjoining fields did not show evidence of blight at that time, July 7-8. (Giddings).

Kentucky: A very slight amount of late blight reported in October from Louisville. (Valleau).

North Carolina: Very common this year in some mountainous sections. Potatoes were planted rather early, the weather was abnormally warm, and blight did not appear before the potatoes were dying. Did slight damage to the winter crop grown on the Eastern Shore. (Foster).

Michigan: Specimens in early phase of decay from Alpena County, September 4. Specimens were seen and reports of tuber rots in car shipments confirm existence of blight in this section. (Coons).

Wisconsin: Of minor importance in local areas (Price, Rusk, and Washburn Counties), reducing the yield for the state very slightly. The maximum found in any one field was 75%. First reported September 27. It is probably attributable to local showers. (Vaughan).

Minnesota: Not observed this season. (Section of Plant Pathology).

Iowa: None present. (Melhus).

South Dakota: About 5% found in one field near St. Onge. (Petry).

California: Late blight was severe in Humboldt County. There are 400 acres of potatoes, of which about 150 acres are affected. It seems that this disease as found in Humboldt County does not develop readily elsewhere. (Milbrath).

Philippine Islands - Trinidad, Mountain Province: The temperature of this region, due to the high altitude, is rather low compared with the rest of the Philippines. The most serious disease prevalent during the period in which observations were made, was the late blight of potatoes. According to Mr. Wright, Superintendent of the Trinidad Farm School, this disease is the limiting factor in Irish potato production. Likewise the disease is very serious on tomatoes and is also the limiting factor in their production. Late blight is easily checked by spraying with Bordeaux mixture every two weeks throughout the growing season; so the loss which has hitherto resulted from this disease may be entirely prevented. (Colin G. Welles[1] - December).

Losses from late blight in 1921

Table 42. Estimated reduction in yield from late blight as reported by collaborators, 1921.

Percent reduction in yield	States
5	Pennyslvania
2	West Virginia, North Carolina
.5-1	Maine
.3	New York
t	Michigan, Wisconsin, Washington, Oregon

Table 43. Losses from late blight in New York State by Counties for 1921. (Chupp).

County	Percent of crop loss	County	Percent of crop loss	County	Percent of crop loss
Allegany	0.24	Essex	v.s.	Steuben	v.s.
Broome	v.s.	Franklin	v.s.	Suffolk	v.s.
Cayuga	0.16	Genesee	v.s.	Tioga	v.s.
Chemung	v.s.	Livingston	v.s.	Tompkins	v.s.
Chenango	v.s.	Nassau	v.s.	Warren	v.s.
Clinton	v.s.	Oneida	0.24	Washington	v.s.
Cortland	0.85	Onondaga	v.s.	Wyoming	v.s.
Erie	v.s.				

v. s. Very slight. (A trace was reported from most counties.)

Table 44. Losses from late blight of potatoes, caused by *Phytophthora infestans*, as shown by examination of cars at destination by inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	Range of dates of inspection	No. of cars with decay	Average percentage of decay	Range of percentages of decay: No. cars	Range of percentages of decay: Percent	Remarks
		1920 crop				
Delaware	April 25	1	4	1	4	With slimy soft rot
Florida	April 13-29	4	36	2	60-70	
				2	1-12	
Idaho	Febr. 7	1	5	1	5	With Fusarium
Maine	Jan. 10-June 17	135	3	20	5-14	
				115	1-4	
Maryland	April 20-June 4	4	4	4	2-9	
Michigan	Jan. 13 - May 31	11	3	1	10	
				10	2-4	
New Jersey	March 16	1	5	1	5	With Fusarium
New York	Jan. 6 - June 10	139	3	33	5-10	
				106	1-4	
Oregon	Jan. 14	3	24	3	18-33	
Pennsylvania	Jan. 5 - May 2	17	5	10	5-14	
				7	1-4	
Virginia	March 15-June 22	6	2	6	1-5	
Wisconsin	Jan. 5	1	3	1	3	
Canada	Jan. 8 - June 2	38	2	5	6-9	
				33	1-4	
Unknown	Jan. 28-June 10	9	6	1	35	With slimy soft rot
				8	1-4	

Total.................. 370

Origin of shipment	Range of dates of inspection	No. of cars with decay	Average percentage of decay	Range of percentage of decay		Remarks
				No. cars	Percent	
		1921 crop				
Maine	Sept. 20-Dec. 12	100	4	1	40	With other decays
				16	5-20	
				83	2-4	
Michigan	Oct. 28 - Dec. 1	9	5	3	5-12	
				6	2-4	
New Jersey	Sept. 1	1	2	1	2	
New York	Sept. 13-Dec.12	48	3	6	5-15	With other decays
				42	1-4	
North Carolina	June 6-17	2	31	2	5-57	" " "
Pennsylvania	Nov. 10-23	2	2	2	2	
Virginia	Nov. 30	1	1	1	1	
Washington	Oct. 26	1	5	1	5	
Unknown	Nov. 1-18	4	4	1	9	
				3	1-4	

Total.................... 168
Total number cars potatoes inspected (calendar year)... 2749

Dates of first observation of late blight, 1921

April 14...........	Florida
June 23.............	Suffolk County, N. Y. (Chupp)
July 2..............	Randolph County, W. Va. (Giddings)
July 7-12...........	Avery County, North Carolina (Shapovalov)
July 26.............	St. Onge, S. D. (Petry)
July 30.............	Humboldt County, Calif. (Milbrath)
August 5............	Somerset Co., Pa. (Well distributed, Nixon)
August 15...........	Bath, Steuben County, N. Y. (Fernow)
August 20...........	Present in 9 counties in Pa. (Thurston)
September 1-13......	General outbreak in New York (Chupp)
September 4.........	Alpena, Mich. (Coons)
September 8.........	Brattleboro and in Orange Co., Vt. (Gilbert)
September 11	Amherst, Mass. (Osmun)
September 13........	Aroostock County, Me. (Morse)
September 14........	New Hampshire (Butler)
September 27........	Park Falls, Price County, Wis. (Vaughan)
Digging time........	Price and Rusk Counties, Wis.

Recent literature

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Murphy, P. A. The sources of infection of potato tubers with the blight fungus, _Phytophthora infestans_. Sci. Proc. Roy. Dublin Soc. n.s., 16: 353-368. Aug. 1921.

Pennington, S. and H. G. Robinson. Spraying of potatoes for "blight" or "potato disease" (_Phytophthora infestans_). Bul. Univ. Coll. Reading 30: 1-(9). Diagrams. June 1921.

Pethybridge, G. H. Some recent work on the potato blight. Rep. Intern. Potato Conf. 1921: 112-126. Illus. (1922).
List of books quoted: p. 123-125.

Early blight caused by _Macrosporium solani_ E. & M.

This disease, referred to in the 1920 summary (Pl. Dis. Bul. Suppl. 16: 187-188. June 1, 1921.) as one of the four or five most universal potato diseases in the United States and which was in 1920 of slight importance, was this year, in contrast to 1920 conditions, of great importance in many states as the following table of losses indicates:

Table 45. Losses from early blight in 1921, as reported by collaborators.

State	Percent loss	1921 December forecast	Loss computed in bushels
West Virginia	3.0	4,080,000	126,000
Kentucky	15.0	3,770,000	665,000
Tennessee	5.0	1,820,000	96,000
North Carolina	1.0	4,048,000	41,000
Mississippi	2.0	1,088,000	22,000
Texas	1.0	2,072,000	21,000
Ohio	1.0	6,728,000	68,000
Indiana	1.5	3,570,000	54,000
Michigan	10.0	27,200,000	3,022,000
Minnesota	1.5	27,525,000	42,000
South Dakota	2.0	4,400,000	90,000
Kansas	5.0	4,160,000	219,000
Colorado	10.0	11,070,000	1,230,000
Utah	1.0	2,415,000	24,000
California	2.0	10,064,000	205,000
Total			5,925,000

The following states reported early blight as of less importance than last year, with losses under 1%: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Florida, Mississippi, Louisiana, Arkansas, Wisconsin, Iowa, North Dakota, Arizona, and Idaho.

The following reports from western states, reiterative of similar reports for 1920 are worthy of record and conditions in the areas merit further investigation.

Montana: Reported no early blight seen, doubt if it occurred this year - found only once in past ten years. (Jennison).

Washington: No authentic reports. (Dana).

Weather relations to early blight

From an analysis of conditions at Waupaca, Wisconsin in 1917, R. D. Rands[1] made the following summary of weather relations as they affect early blight epidemics:

> (1) "In order to have the optimum conditions for an epidemic there must be relatively high temperatures in combination with a more or less weakened condition of the plant so that the fungus can make its greatest spread.
>
> (2) "That such development will not occur unless the above conditions are prefaced by relatively moist periods of high humidity and abundant dew or rainy weather when spore production and infection can readily take place."

The prevalence of early blight (expressed by symbols in use in the Plant Disease Survey) is indicated by states, so far as data are at hand, on the accompanying maps of the United States (Figs. 67 and 68). It will be noted that the New England states, which has low rainfall in August and September, had but slight attacks of early blight, while the states that reported considerable loss - West Virginia, Kentucky, Tennessee, Michigan, Indiana,

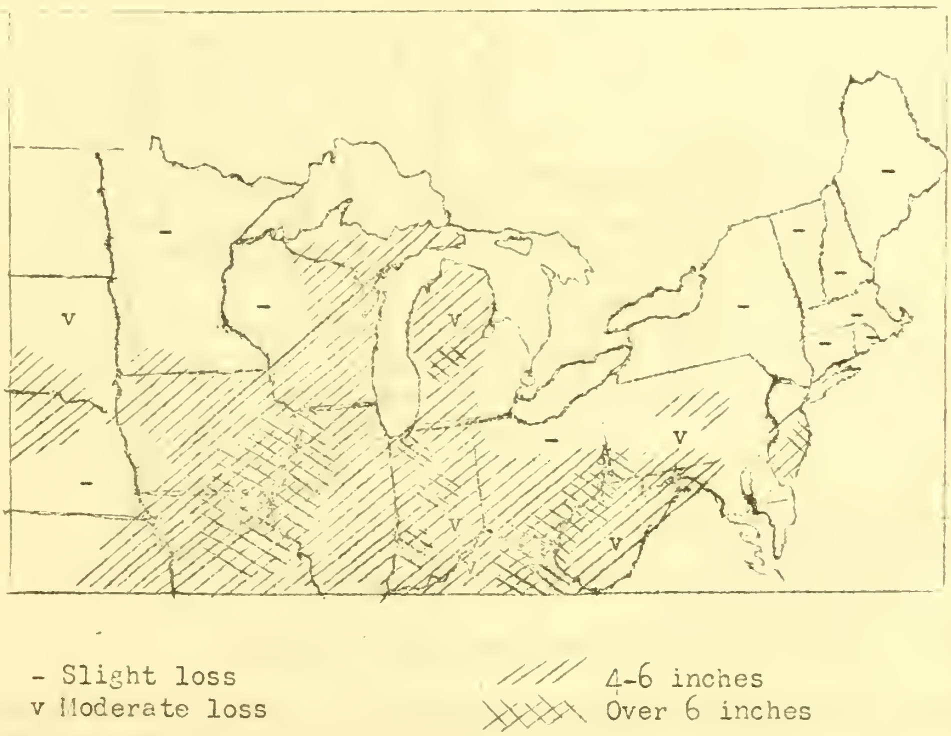


Fig. 67. Rainfall map for August, 1921 with early blight loss indicated. (Adapted from Nat. Weather and Crop Bul. series 1921^{38}: Sept. 21, 1921.)

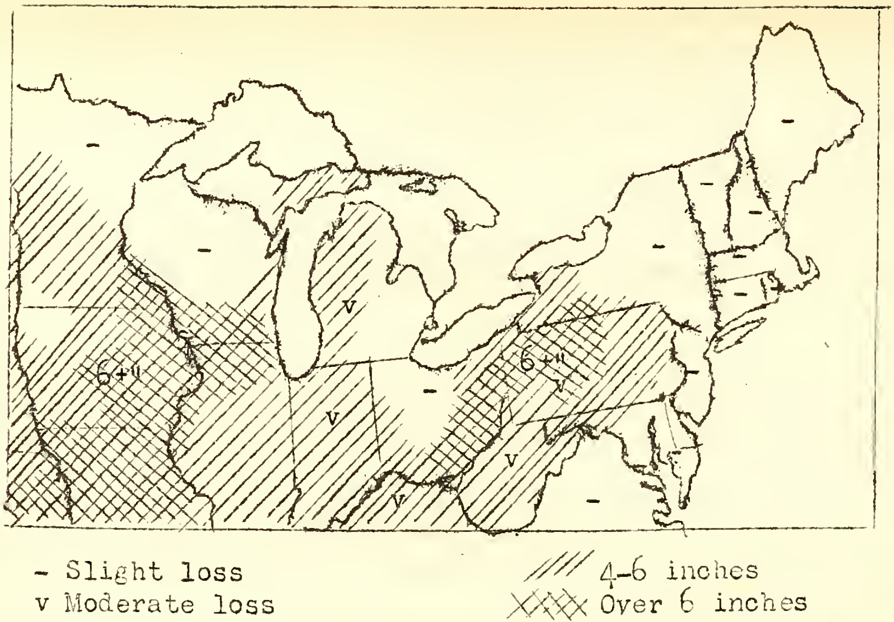


Fig. 68. Rainfall map for September 1921 with early blight loss indicated. (Adapted from Nat. Weather and Crop Bul., series 1921[42]: 7. Oct. 19, 1921.)

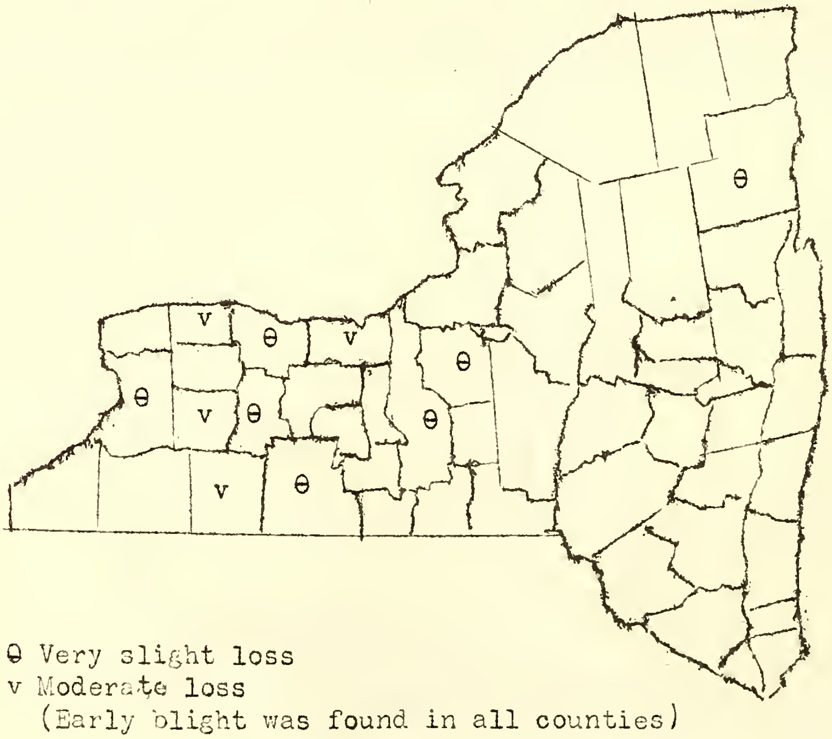


Fig. 69. Early blight in New York, 1921. (Chupp).

Kansas, South Dakota, are for the most part those in which rainfall was most plentiful. From a comparison of these maps with the prevalence reports of early blight, especially when the high temperature conditions of 1921 are recalled, the accuracy of Rand's conclusions is apparently confirmed.

From a comparison of the accompanying map (Fig. 69) indicating the severity of early blight in New York, according to the results of the rather large number of field inspections in the state, with the rainfall map for September (Fig. 68), a correlation of the prevalence of early blight with late summer rainfall similar to that shown for the country in general is apparent for New York.

Reference

1. Rands, R. D. Early blight of potato and related plants. Wisconsin Res. Bul. 42: 486, p. 37. 1917.

Fusarium blight caused by *Fusarium oxysporum* Schlecht., and related organisms

Fusarium blight or wilt, typically known as a hot weather and warm soil disease, was especially prevalent last year in all sections except those where rainfall was plentiful. The reports available to the Survey are summarized in Table 46, and some of the more significant statements of collaborators and others are quoted below.

Western states: Fusarium wilt, blight and other diseases of this group always have been and remain a problem of the utmost importance in the West. While instances may be observed where infection is close to 100% we have no effective measure of control to offer. We have seen a good deal of sad conditions. Now we have practically reached the point where it is imperative for us to make a decisive transition into the domain of augmented experimental activities. The control measures for the Fusarium diseases should be studied from the view point of both the soil and the seed infection. It must be considered also that the Fusarium troubles of the potato plant are not caused by any single species of this fungus, as was once supposed, but by several species of this genus. It is quite probable, therefore, that the ultimate control measures may differ with the different species. (Shapovalov).

Washington: I think that disease conditions are worse in the Yakima Valley than they have been for a long time, especially on potatoes. Up to the present time, I have not considered that the Fusarium wilt was a factor in this state in disease work. The first field that I visited at Wapato, I found praotically 99% Fusarium. (Zundel, August 23).

Upon closer observation, the Fusarium wilt in the Yakima Valley is probably the western field rot (*Fusarium radicicola*). (Zundel, September 3).

New York: The weather was hot and dry which seems to favor wilt. (Chupp).

Indiana: Many indications that disease arises primarily from soil rather than a seed infection. (Gardner).

Montana: Hot, dry July and August seemed to increase disease. (Jennison).

Table 46. Relative prevalence and importance of Fusarium wilt, F. oxysporum and related organisms, as reported by collaborators, 1921.

State	Prevalence compared with Last year	Prevalence compared with Average year	Importance	Losses	Nature of injury	Geographic range	Earliest appearance Date	Earliest appearance Place
Vt.			Unimportant	1-5%	"Gilbert reports occasional pronounced and severe cases."(Lutman)			
N. Y.	More	More	Rather imp.	1.5%	50% highest in any field (See Chupp's report)	Whole state	Aug. 20 July	Corinth Tompkins
Pa.	Same	Same		Not severe.	Found in warmest portion	Southeast section		
Md.				Trace				
Va.	More complaints					General		
Ky.	Same		Important	5%	20% of fields show 1-15%, maximum in field 15%			
N. C.				3%	Most destructive in early crop			
Miss.	Trace	Same		Trace	Important locally		May 8	Crystal Spr.
Ark.				2%				
Ohio		Same			Temperature and moisture favorable		July 9	Richland Co.
Ind.	Less	Less	Serious	.5%	Heat favored, cool August and September checked		Aug. 8	LaPorte Co.
Minn.	More			1%			Sept.20	Ramsey Co.
N. D.	Less	Less			Best results by selection and by stem-ending			
Nebr.				10%				
Mont.	More	More		2-3%	Especially severe in east			
Colo.	More	More					Aug.	Delta
Ida.	More		Important	5%	General, most severe in southern irrigated section			
Calif.				8%				

Colorado: Fusarium wilt, the chief and most serious disease has made its appearance in every field. The season is considerably advanced and there has been a prolonged hot spell, consequently the disease has already become well established. (Shapovalov, August 6).

Very prevalent and extremely bad in many individual cases. A few fields were a total failure on this account. (MacMillan, October 31).

Table 47. Losses caused by Fusarium wilt reported by collaborators; with yields as given by the Bureau of Markets and Crop Estimates. (Monthly Crop Reporter 7: 154. Dec. 1921.)

State	Percentage reduction in yield	Production December 1921 crop estimates (Bushels)	State	Percentage reduction in yield	Production December 1921 crop estimates (Bushels)
N. Y.	1.5	33,990,000	Minn.	1.0	27,525,000
Pa.	3.0	21,586,000	Nebr.	10.0	8,160,000
Ky.	5.0	3,770,000	Mont.	2-3	5,060,000
Miss.	Trace	1,088,000	Colo.	3.0	11,070,000
Ark.	2.0	1,815,000	Ida.	5.0	10,545,000
Ohio	4.0	6,728,000	Calif.	8.0	10,064,000
Ind.	.5	3,570,000			

Special reports

Table 48. Percentages of Fusarium wilt in potato fields in Nebraska as shown by field inspections, 1921. (Goss and Werner).

County	Number of fields inspected	Acreage	Variety	Average percentage Fusarium wilt
Box Butte	12	442	Triumph	5.33
	2	31	Early Ohio	1.75
Dawes	9	86.5	Triumph	.49
	3	11.5	Early Ohio	2.05
Kimball	10	170	Triumph	4.67
Scotts Bluff	1	11	Triumph	1.00
	1	10	McClure	10.00
	1	7	Early Ohio	3.00
Sioux	2	22	Early Ohio	.50
Total and average	41	791		3.20

Wart caused by Chrysophlyctis endobiotica Schilb.

Wart continues to be regarded as a disease of major importance both abroad and in the United States. Results of surveys showing the narrowly restricted distribution in America, and reports of strict and efficient quarantines have reassured growers and workers as to the American situation. The great extension of the disease in England and Scotland[2] due to the effects of the war on trade movements, and the extensive tests of varietal resistance[1] are worthy of note by those interested. The fact that no varieties of the Rural group are immune makes potato wart have particularly dangerous significance to the American potato growing industry. The following statement by Weiss and Orton[3] of experimental work in the United States summarizes the results of federal and state investigations.

> "Potato and tomato remain the only demonstrated American hosts. Seven additional varieties of American potatoes are provisionally classed as immune, making 34 in all out of 103 varieties tested, but the number of types of immune potatoes remains the same; namely, McCormick, Green Mountain, Cobbler, Spaulding Rose, Ehnola, and Burbank, while the Rural New Yorker, Early Ohio, Early Rose, Triumph, Early Michigan, Pearl, and Up-to-date types are susceptible. Eggplant, cayenne and pimento peppers, petunia, tobacco, _Datura_ sp., _Solanum integrifolium_, and _S. carolinense_ are not susceptible to wart disease. _S. nigrum_ and _S. dulcamara_ have never been found infected in America. Infection of highly susceptible varieties occurred in June during heighth of growth, but in general both infection and development of tumors were retarded by dry soil or high temperatures. In controlled soil temperature experiments infection occurred at 22°C., which is above optimum for growth of potato."

The 1921 potato wart survey

The status of survey work on this disease is presented thus by G. R. Lyman and G. Hamilton Martin, Jr.

> "The intensive survey of suspicious areas in Pennsylvania, West Virginia, and Maryland, initiated in 1919, continued in 1920 by the Plant Disease Survey acting for the Federal Horticultural Board and with the Experiment Station authorities of the states concerned, was further carried on by seven field assistants in 1921. The field work of the 1921 survey began at Freeland, Pennsylvania July 7 and ended on August 27.
>
> "The survey was confined to Pennsylvania, West Virginia, and Maryland, the three states within whose borders wart was already known to exist. _No new findings were made in West Virginia_. _Unimportant extensions_ of the territory known to be infested were made in Pennsylvania by field men of the State Department of Agriculture. In Maryland, field men, cooperating with officials of the State Agricultural Experiment Station at College Park, thoroughly surveyed the coal districts of Allegany and Garrett Counties and _found wart in three new towns, making six towns in that region now known to be infested_.
>
> "_Pennsylvania_: This year's work completed the survey of the bituminous mining districts in western Pennsylvania where wart seems most likely to have become established. Many industrial towns were also surveyed in the counties visited, together with a number of lumbering settlements. No additional areas of infestation were found either by the Federal inspection party or by the field men of

the Pennsylvania Department of Agriculture. State officials, however, found a single case of wart at White Haven in the Hazelton district, which had been included in the quarantined areas under suspicion, although no wart had ever been found there. In western Pennsylvania a state quarantine officer found wart in the town of Onnalinda in the immediate neighborhood of Beaverdale and Llanfair, which places were already known to be infested.

"With the close of the year's survey all the areas in Pennsylvania have been covered which, from our past experience, would appear to be especially suspicious. Further survey work on the past season's basis would seem to be unwarranted, though the quarantine officials must be on the watch for sporadic cases which may have escaped detection by the survey groups.

Table 49. Present known distribution of wart in the United States, 1921. (G. Hamilton Martin, Jr.).

Town	County	State	No. of infested gardens known	Date of discovery	Discovered by
Nanty Glo	Cambria	Pa.	2	8-27-19	Plant Disease Survey men
Lilly	"	"	1	9-13-19	" " " "
Llanfair	"	"	12	9-23-19	" " " "
Osceola Mills	Clearfield	"	5	10-8-19	" " " "
Vintondale	Cambria	"	2	10-8-19	" " " "
Clarence (Snow Shoe)	Center	"	2	10-14-19	" " " "
Woodvale	Huntingdon	"	2	7-29-20	" " " "
Robertsdale	"	"	7	8-3-20	" " " "
Janesville (Smithmill)	Clearfield	"	2	9-1-20	" " " "
Beaverdale	Cambria	"	1	8-18-20	Pennsylvania State men
Yatesboro	Armstrong	"	3	-----20	" " "
Onnalinda	Cambria	"	15	-----21	" " "
White Haven	Luzerne	"	1	-----21	" " "
Whitmer	Randolph	W.Va.	2	9-9-19	Plant Disease Survey men
Thomas	Tucker	"	21	9-12-19	" " " "
Coketown	"	"	2	-----20	West Virginia State men
Pierce	"	"	2	-----20	" " " "
Lord	Allegany	Md.	1	9-15-20	Plant Disease Survey men
Mt. Savage	"	"	4	9-19-20	" " " "
Eckhart Mines	"	"	2	9-21-20	" " " "
Detmold	"	"	3	8-5-21)	Plant Disease Survey and
Charlestown	"	"	1	8-10-21)	Maryland State party
Midland	"	"	1	8-10-21)	

"West Virginia: The southern West Virginia coal fields were thought worthy of further attention on account of the constant migration of miners between the northern and southern coal fields and also on account of the railroad down the Greenbrier Valley which affords an opportunity for constant communication between the two parts of the state. A few suspicious localities in the northern section also required attention.

"No wart was found, all suspicious cases reported proving to be severe scab infection, although conditions in many of the gardens visited appeared to be favorable for the development of wart."

"Maryland: The coal areas of Maryland are confined to Garrett and Allegany Counties in the western end of the state. This region was rapidly surveyed by our field assistant in 1920 and wart found in three towns, - Lord, Mt. Savage, and Eckhart Mines, one infested garden being discovered in each town. In 1921 all mining villages and communities in Allegany and Garrett Counties were visited together with a number of neighboring farming communities.

"Wart was discovered at Detmold on August 5, at Charlestown and Midland on August 10, Eckhart Mines on August 11, and at Mt. Savage on August 23. Wart was first discovered at Eckhart Mines and Mt. Savage last year, but was found this year in new gardens on the dates mentioned.

"Wart is now known in six mining towns with a total of twelve infested gardens as follows: Lord, one garden; Mt. Savage, four gardens; Eckhart Mines, two gardens; Detmold, three gardens; Charlestown, one garden; and Midland, one garden. It is reasonably certain that wart is also present in a number of other localities. This can be determined only by future search."

Importance of the Maryland situation

"In certain respects conditions in Maryland differ from those generally present in the infested districts of Pennsylvania and West Virginia, and there appears to be greater danger of the disease spreading to new territory. In considering the Maryland situation the following facts should be borne in mind.

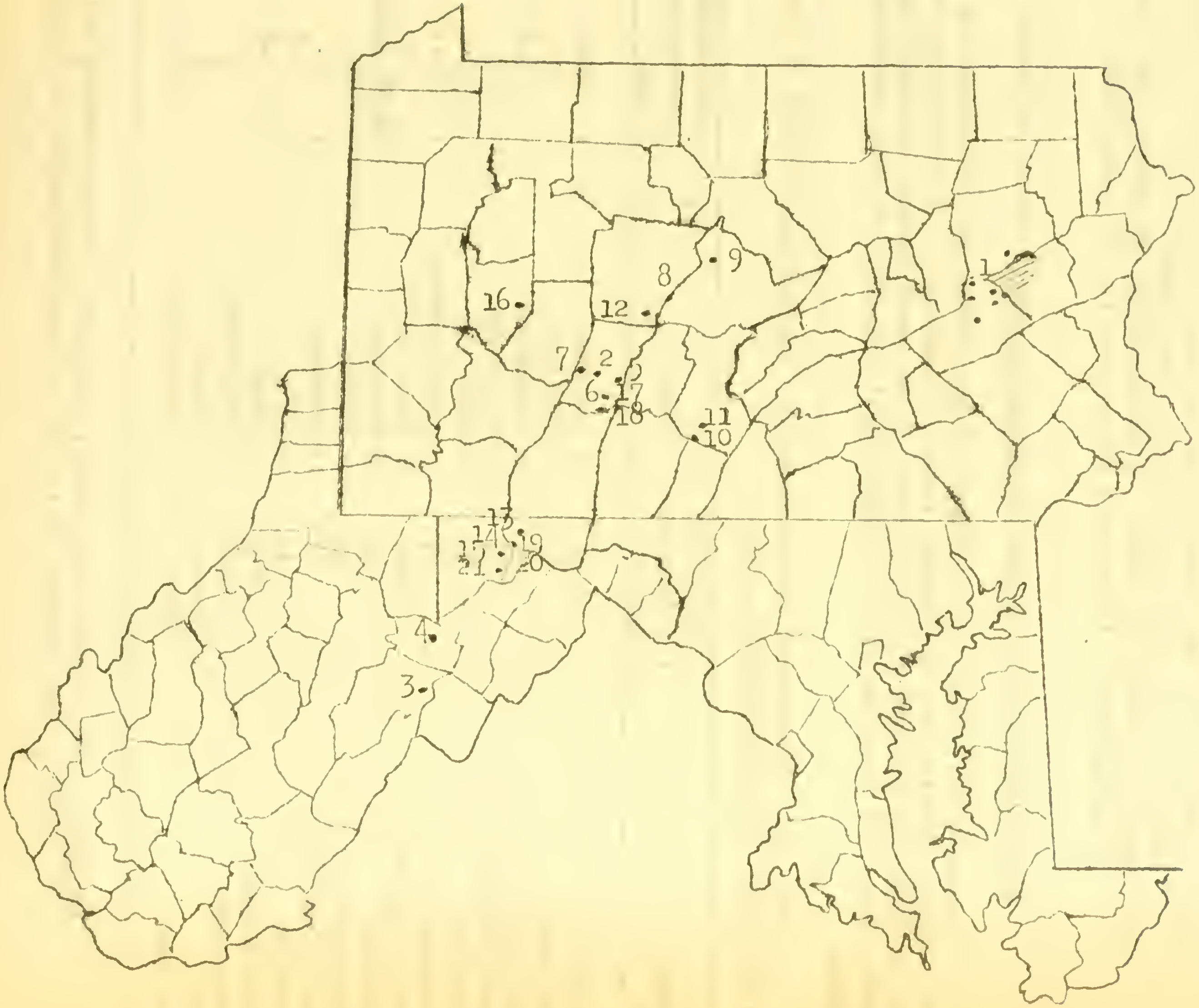
"(a) Seed potatoes are extensively grown in this region and certain seed potato fields at Eckhart Mines lie only a short distance from infested gardens.

"(b) The wart infested villages are not isolated from farms by uncultivated lands, but in many cases are immediately surrounded by tilled fields. Therefore, there is grave danger that the disease may spread from miners' gardens to neighboring farm lands.

"(c) The people are largely Americans who have lived in that region for generations. In the case of many families, certain members are farmers and others miners. The constant intercourse between the various members of such a family greatly increases the danger of wart spreading from gardens where it is now known.

"(d) The infested region is not isolated, but is readily accessible by the National Pike from Cumberland, the Westernport Pike from Westernport and Piedmont, and by electric railways from Cumberland and Westernport.

"(e) The infested villages are but a short distance removed



LEGEND

1. Original Eastern
   Pa. area
2. Nanty Glo
3. Whitmer
4. Thomas
5. Lilly
6. Llanfair
7. Vintondale
8. Osceola Mills
9. Clarence
10. Woodvale
11. Robertsdale
12. Smithmill
13. Mount Savage
14. Eckhart Mines
15. Lord
16. Yatesboro
17. Beaverdale
18. Onnalinda
19. Midland
20. Charlestown
21. Detmold

Fig. 70. Known distribution of potato wart in the United States, 1921.

from the Pennsylvania state line on the north and the West Virginia line on the south."

In Maryland, therefore, survey work must be emphasized, and we must look to State authorities there to inaugurate a strong, effective quarantine to protect the adjoining districts.

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Rhizoctonia disease caused by Corticium vagum Berk. anc Curtis

Rhizoctonia, which caused damage by decimating stands, cankering stems and stolons, causing rot of feeding roots (Minnesota), and blemishing tubers, was an important disease in many states, as is shown by the accompanying table (Table 50) compiled from collaborators' reports; and the quotations below.

Table 50. Percentage losses caused by Rhizoctonia disease of potato, as estimated by collaborators, 1921.

State	Estimated percentage loss	State	Estimated percentage loss
Vermont	.5-1%	Indiana	0.2
New York	1.5	Michigan	5.
New Jersey	3.	Wisconsin	0.1
Pennsylvania	3.	Minnesota	1.
Maryland	3.	Iowa	6.
Virginia	2.	North Dakota	0.1
West Virginia	Trace	South Dakota	2-5
Kentucky	5.	Nebraska	3-5% infection
Tennessee	1.	Kansas	15.
North Carolina	6.	Montana	2.
Georgia	1.	Utah	2.5
Mississippi	Trace	Idaho	7-8
Louisiana	Rare	Washington	8.
Texas	Trace - 1	Oregon	8.
Arkansas	Trace - 3	California	8.

Vermont: More serious than usual, resulting in many missing hills early in the season; 10 to 15% in some fields. (A. H. Gilbert).

New York: The first appearance recorded was June 6 in Suffolk County. No varieties were resistant, and Cobblers were probably most susceptible. (Chupp).

New Jersey: Less than last year; 5% of plantings in state were infested. (Cook).

Pennsylvania: General. (Thurston and Orton).

Virginia: Norfolk County. Occasional plants affected with Rhizoctonia were found, probably not more than 1-2% on the average. (Fromme).

Kentucky: Important, causing 5% reduction in yield for the state. Found only in early crop, doing injury to underground stems. (Valleau).

South Carolina: Present in abundance on northern seed shipped in for planting the early crop. May have been contributing cause for a rot of seed pieces in the ground with consequent failure of plants to come up in Charleston County. (Ludwig).

Florida: Especially noticed in the Hastings district. The seed planted was said to be certified. (Burger).

Mississippi: Unimportant. (Neal).

Louisiana: Rarely occurs. (Edgerton).

Texas: Prevalent, 1% loss. (Taubenhaus).

Arkansas: Of little or no importance. (Elliott).

Indiana: Worse than last year or the average year. (Gardner).

Wisconsin: Less than for several years, apparently associated with high soil temperature. Seed treatments with corrosive sublimate proved very effective. Not any appreciable reduction of stand this year. (Vaughan).

North Dakota: At present it seems likely to be the chief bar to extensive potato certification. (Bolley, October 15).

One of our most serious diseases. (Couey).

South Dakota: In most localities. (Evans).

Our worst infectious potato disease. (Petry).

Nebraska: (See Table 51).

Kansas: Worse than usual, causing at least 15% reduction in yield. Attacked stems underground causing missing hills and weak plants. Occurred in every potato patch. First appeared May 2, in Wyandotte County. Cool, wet spring; cooler than usual. Twenty-two hundred acres treated as a result of demonstrations covering a period of 3 years. Average increase in yield due to treatment, 19 bushels. (Stokdyk).

Table 51. Percentages of Rhizoctonia in potato fields inspected in Nebraska, 1921. (Goss and Werner).

County	Number of fields inspected	Acreage	Variety	Average percentage Rhizoctonia
Box Butte	14	469	Triumph	2.54
	2	31	Early Ohio	5.00
Dawes	13	169	Triumph	.78
	4	16.5	Early Ohio	4.00
Kimball	8	147	Triumph	2.41
Sioux	4	56	Triumph	1.12
	1	3	Downing	1.00
Scotts Bluff	1	10	McClure	t
	1	7	Early Ohio	1.00
	1	11	Triumph	t
Total and average	49	919		1.88

Western States: Rhizoctonia disease under certain seasonal conditions becomes very active in the West, as has been the case this year. It should be learned why and how this occurrence takes place and what can be done to prevent the losses. (Shapovalov).

Montana: Very common and widespread. (Jennison).

Colorado: In some cases it has prevented seed certification. (Learn). As the season progressed Rhizoctonia developed and did about 15% of the total damage incurred in the Greeley district. (MacMillan).

Arizona: Most serious with Peerless. (Brown).

Washington: More trouble this year than usual. I find that potatoes planted from the latter part of April up to and including the middle of May are diseased, ranging as high as 80% Rhizoctonia. Potatoes planted after May 15 and up to and including the fore part of June show very little disease. (Zundel).

Oregon: Probably same as usual; our most prevalent and destructive disease. Fifty percent of plants in some fields dying. Caused blight of stolons and roots and stem base. Coextensive with host. First reported June 4, from Hillsboro. Corrosive sublimate gives excellent control where soil is clean. (Barss).

California: Very severe in Delta region. (Milbrath).

Scab caused by Actinomyces scabies (Thax.) Güssow

This disease, now generally recognized as influenced profoundly by soil reaction, soil infestation, cleanness of seed, and rate of growth of tubers, was reported generally from eastern United States but is known through survey records from every state. Although seven states report the disease as more severe, no striking effects of hot weather were noted by collaborators, doubtless such relations being masked by the other factors influencing prevalence.

Table 52. Reports on relative prevalence of scab during 1921.

Prevalence of scab	States
More	New York, New Jersey, Maryland, Arkansas, Indiana, Wisconsin, North Dakota, South Dakota, Washington.
Usual	Pennsylvania, Ohio, Michigan, Minnesota, Iowa, Idaho, Colorado, Oregon (probably).
Less	West Virginia, Mississippi.

Table 53. Losses from potato scab in 1921 as reported by collaborators. (Crop estimates from Monthly Crop Reporter, December 1921.)

State	Amount of disease	Size of crop, bushels. December, 1921, estimate
New York	1%	33,990,000
New Jersey	Very severe in early crop	9,025,000
Maryland	3%	3,185,000
Mississippi	5%	1,088,000
Arkansas	5%, fairly serious	1,815,000
Ohio	2%	6,728,000
Indiana	Considerable	3,570,000
Wisconsin	5%, general	21,420,000
Minnesota	1%	27,525,000
Iowa	6%	4,128,000
South Dakota	5%	4,400,000
Oregon	Not very important	3,870,000
California	3% (2% spring crop, 4% southern California)	10,064,000

The following tabulations of figures, obtained during field inspections in New York and Nebraska are included to show the importance of scab and to record some unusually high percentages met with in certain fields. The data are too meagre to allow any generalization as to reasons for the high percentages in certain counties, but more intensive work along this promising line would doubtless show strong correlation with some of the factors influencing scab. It should be said that not all of the seed used in these fields was treated, nor was it all certified seed.

New York: I have been down on Long Island the past week and have inquired about the prevalence of potato scab there during 1921. I find that scab was very generally prevalent over the Island and that the losses resulting from it have been estimated by a committee to amount to $500,000. This may be inaccurate in a way but probably represents in a relative way the losses due to this disease. (M. F. Barrus).

Table 54. Percentages of scab in potato fields inspected in New York during the summer of 1921. (Barrus and Chupp).

County	Number of fields inspected	Acreage	Average percentage of scab
Allegany	18	59.00	1.30
Cayuga	17	54.50	0.35
Chenango	5	12.75	0.63
Clinton	9	42.50	0.43
Cortland	45	176.75	2.26
Erie	28	62.00	5.22
Essex	5	18.50	0.01
Franklin	48	188.01	1.49
Genesee	9	102.50	3.51
Livingston	7	37.50	2.63
Madison	3	6.00	1.17
Monroe	41	186.30	4.72
Niagara	4	6.75	34.78
Oneida	19	55.83	18.79
Onondaga	22	83.33	1.79
Ontario	15	64.16	9.01
Orleans	7	45.00	16.40
Oswego	8	25.00	3.25
Seneca	9	39.75	11.17
Steuben	10	53.50	2.81
Washington	75	170.15	Trace
Wayne	11	23.00	4.70
Wyoming	11	27.00	0.30
Total	426	1539.78	3.81

Table 55. Percentages of common scab in potato fields inspected in Nebraska, 1921. (Goss and Werner).

County	Number of fields inspected	Acreage	Variety	Average percentage common scab
Box Butte	10	377	Triumph	13.50
	1	6	Early Ohio	30.00
Dawes	3	53.5	Triumph	1.53
Kimball	2	80	Triumph	1.15
Scotts Bluff	1	7	Early Ohio	2.00
	1	11	Triumph	5.00
Sioux	3	52	Triumph	1.33
Total and average	21	586.5		8.71

Varietal susceptibility

The following reports concerning the susceptibility of varieties were received from collaborators:

New York: American Giants said to be less susceptible Washington County, where only American Giants are grown, shows only a trace of scab. (Chupp).

Wisconsin: Less on Rural New Yorker than other varieties. (Vaughan).

J. W. Brann and R. E. Vaughan[1] give the following table based on tests conducted at the Wisconsin Experiment Station.

Table 56. Occurrence of scab on six leading Wisconsin varieties. (Brann and Vaughan[1]).

	Average percent of scab		Average percent of scab
Late varieties		Early varieties	
Rural New Yorker	24	Early Ohio	44
Burbank	32	Triumph	51
Green Mountain	40	Irish Cobbler	62

Michigan: Russet Rural (Late Petoskey) is notably scab resistant. (Kotila).

Minnesota: Russet Burbank is affected but slightly by scab. (Stakman).

Control of scab

1. Sulfur treatment of soil

Interest in sulfur treatments for scab continues and while the applicability of this method is limited to those areas where potatoes are grown intensively and the use of sulfur almost takes the role of a fertilizer application, or where limestone soils make the raising of clean potatoes impossible without acidulation of the soil, it is to be hoped that this promising treatment will be extensively tried, using ordinary sulfur, finely ground sulfur, and inoculated sulfur.

As a seed treatment device, it is suggested that the time element be considered and that the old experiments of Halsted, in which tubers are rolled in sulfur, be repeated, using the sulfur some months in advance of planting in order that oxidation may take place.

Collaborators' comments on the results of the use of sulfur soil treatments are given below:

Connecticut: Benefit from 600 pounds sulfur per acre in scabby land reported. (Clinton).

New York: Sulfur use becoming common in Nassau County. (Chupp).

New Jersey: The results of experiments on the use of sulfur in various forms as a means of controlling scab have been reported by W. H. Martin in various articles. (See references 3-8 in list below.)

Table 57. Results of experiments in New Jersey with sulfur on potato soils.[3] (W. H. Martin).

Soil treatment	Percent of clean tubers
Average of six tests:	
Untreated soil	8.9
600 lbs. inoculated sulfur	50.9
600 lbs. uninoculated sulfur	33.5
Average of three tests:	
300 lbs. inoculated sulfur	45.7
600 lbs. uninoculated sulfur	39.2

Indiana: C. T. Gregory reports no control with sulfur, 660 pounds per acre in Lake County. (Gardner).

Michigan: No consistent results as yet with sulfur on calcareous soil in Upper Peninsula. Experiments being continued. (Coons).

Wisconsin: We tried out the Bac-sul on a medium heavy loam in Chippewa County and on a light sandy loam in Burnett County. The result of both tests showed no advantage in the use of the sulfur. In fact, there was slightly more scab where sulfur was used, which may be explained on the ground that the soil was not uniformly infested with the scab organism. This experience confirms the experience which we had in 1920. (Vaughan).

2. Other methods

Mississippi: Many are culling and treating seed. (Neal).

Arkansas: Treatment has given negative results. (Elliott).

Michigan: The scab organism is but another plant which can be looked upon as an indicator...... Those soils where clover occurs as a native, and where inoculation is unnecessary, are commonly soils where potato scab is excessive and where seed treatments for scab are uncertain in their results. (Coons[2])

Wisconsin: Both corrosive sublimate and formaldehyde reduced scab decidedly. Corrosive sublimate, however, proved the more effective. (Brann and Vaughan[1]).

Western States: Continued observations and experiments have demonstrated that no standard or uniform potato seed treatment with mercuric chloride can be relied upon to give beneficial results upon certain types of alkaline soils. On some soils treatment results in positive harm to the seed potatoes as compared with untreated control plots. Treatments have to be worked out and modified to meet local soil and water conditions. Formaldehyde is non-effectual against common scab under irrigation where mismanagement in the use of water may cause an excess of soil moisture for an extended period at any time during the early stages of tuber development. Steadily growing plants, either treated or untreated, maintained free from excesses of drought or moisture appear to escape disease a longer time than where improper application of water has occurred. (MacMillan, H. G. Potato seed treatments in western states. (Abstract) Phytopath. 12: 39. Jan. 1922.)

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Blackleg caused by Bacillus phytophthorus Appel

From the reports of collaborators it would seem that while blackleg in general, is a cool climate disease and distributed largely in the northern parts of the country, it has strong capabilities for persistence and its period of appearance is correlated with heavy rainfall. In Michigan, Wisconsin, and Minnesota the early damping-off phase was largely absent, but the disease developed in the fall to some extent. In sharp contrast to the mild form of decay in Minnesota is the heavy decay according to inspection reports in North Dakota. The weather for August in North Dakota, where blackleg appeared between August 15 and September 1, is of great interest in this connection, the following being the official summary[2]:

> "The temperature and precipitation for the month averaged near the normal, the former being slightly above and the latter slightly below the normal. The first decade was the driest and during this period harvesting of small grain was practically completed. The ground, however, was mostly too dry for fall plowing and late planted potatoes suffered. The second decade was the coolest of the month and frequent showers, in many instances quite heavy, relieved the drouth conditions. The third decade was the warmest as well as the wettest and at the close of the month the ground was generally in excellent condition. The mean temperature was 60.2° or 1.8° above the normal."

Field decay in the Western States, previously obscurely known, has been thought to be the result of attacks of a variety of organisms. The form of rot on Netted Gem is typical of the manifestation in the East, the decay taking various forms which simulate other western potato decays.

Shapovalov and Edson[1] have isolated Bacillus phytophthorus from many affected tubers and proved its pathogenicity, and ability to produce the typical disease.

Dates of earliest appearance of blackleg, 1921

April 2...	California, Colma	July 25.....	Minnesota, Polk County
May 5-20..	Indiana, Marion County	August......	Colorado, Delta
May 31....	Ohio, southern	August 2....	Wisconsin
June 6....	New York, Suffolk County	August 8-15.	North Dakota
June 9....	Connecticut, Cromwell		

Recent literature

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Mosaic (cause undetermined)

Potato mosaic continues to be of great interest to workers in plant pathology, mosaic problems at present occupying the attention of many investigators. Results of experimental work conducted in the Office of Cotton, Truck, and Forage Crop Disease Investigations throw much light on the puzzle and undoubtedly have great significance in potato certification work. The former attitude of allowing a fairly high tolerance of mosaic and leaf roll of potatoes (2-5%) in a field inspected for certification, is now being questioned. The following quotation is from a letter distributed to men interested in potato certification by the Office of Cotton, Truck, and Forage Crop Disease Investigations:

> "Dissatisfaction with present standards of certification has been manifested before in reports of southern state workers dealing with the behavior of northern seed under their conditions."

In this connection the following statement made by Edgerton and Tiebout[3] in a bulletin of the Louisiana Station, is also noteworthy:

> "All of the results show definitely that a greater consideration must be given the mosaic disease by the northern growers of certified seed if they expect to make this seed popular in the southern states."

Interesting developments are presaged by fragmentary reports coming from different stations dealing with the selection and increase of either clean or resistant varieties. The work of Blodgett[2] and his associates at New York in developing the index system gives promise, although the matter is not so simple as one might suppose without investigation.

> "The outstanding result of this year was that practically all potatoes thus indexed as being affected with mosaic failed to show symptoms of the disease in the field under conditions prevailing in New York State this year. This result would seem to indicate the general unreliability of counts made on mosaic and the importance of removing mosaic plants by roguing under such conditions."

Blodgett[1] also reports negative results in an attempt to kill potato mosaic virus with hot water treatment from 35-80°C. This is taken to indicate that in the range in temperature used, the time necessary to kill the mosaic virus is longer than that for the killing of the potatoes. Perennial solanaceous plants are mentioned by Melhus[5] and by Gardner and Kendrick[4] as potential reservoirs of the virus.

The following are the comments from collaborators on this disease:

New Hampshire: Not as prevalent this year as last. (Butler).

Vermont: Apparently less than last year but this loss is undoubtedly deceptive as it was very difficult to diagnose with the extreme hot weather. Since it has become cooler, some fields that were apparently free from mosaic are showing it. (Lutman).

None to 10% in inspected fields, with occasional fields running as high as 15-25%. (Gilbert).

Massachusetts: Very severe in some cases, but generally not important where selected northern grown seed was used. (Osmun).

Rhode Island: Very little observed. (Browning).

Connecticut: Probably less than usual. (Clinton).

New York: Reduction in yield wherever potatoes are grown, especially in "white sprout" areas. Extremely bright sunshine masked many of the distinguishing symptoms. (Chupp).

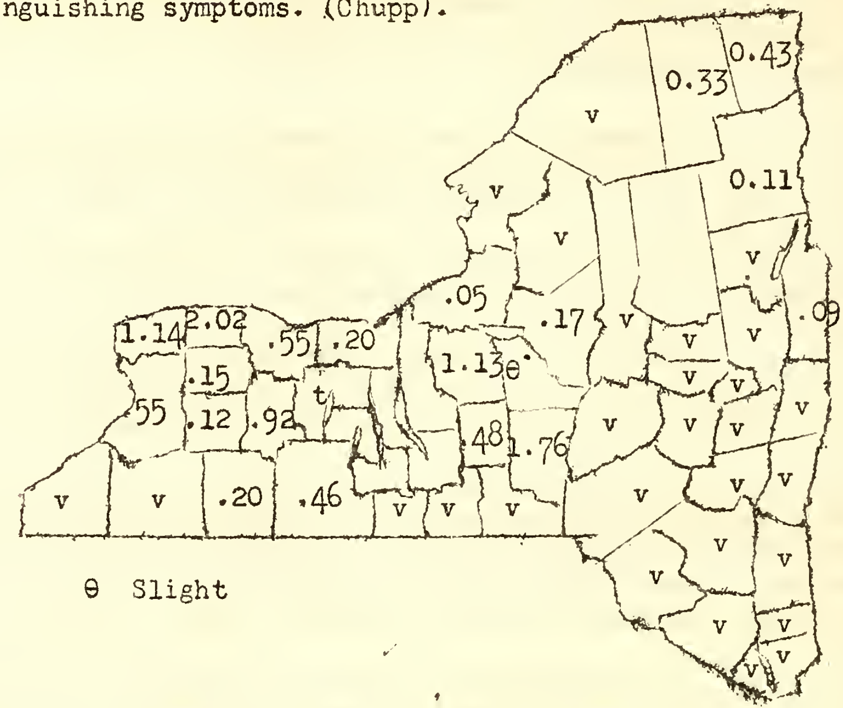

Fig. 71. Average percentage of mosaic found in New York fields during inspection, summer of 1921. (Chupp).

New Jersey: Less than usual, reduction in yield for state 5%. (Cook).

Pennsylvania: As prevalent as usual, most important in northern counties; 1% reduction in yield. Green Mountain and Spaulding Rose most susceptible varieties. (Thurston and Orton).

Virginia: Of slight importance in western part of state, no observations made in eastern section. (Fromme).

West Virginia: No cases observed. (Giddings).

Kentucky: Minnesota certified seed was grown to a slight extent in spring and rather extensively in fall near Louisville. More than doubled common stock in yield and was slightly better than best Louisville stock. (Valleau).

North Carolina: The average infection in the early crop would probably be between 10 and 15%, but in some instances the infection was as much as 50%. Another disease which growers have not recognized as specific and hence do not realize the importance of its control. This disease is being introduced every year through seed purchased from the north. (Foster).

Avery County: Distinct symptoms of mosaic were absent, and it is a significant fact that aphids were also practically absent. (Shapovalov, News Notes, Office of Cotton, Truck, and Forage Crop Disease Investigations. Aug. 6, 1921, page 5.)

South Carolina: Unimportant. (Ludwig).

Florida: Mosaic was prevalent in the Hastings section. In one field of 27 acres the yield was cut to about 20 barrels per acre. The seed came from Maine and was said to be certified. (Burger).

Mississippi: Mosaic continues to be the dominant potato disease in the state. It occurred in about the same amount as last season. Bliss Triumph stock continues to develop a heavy percentage of infection. Observed and reported about the middle of May in practically all the trucking centers in south Mississippi. (Neal).

Louisiana: Very common on Bliss Triumph, causing very serious loss. Disease was particularly bad on potatoes grown from certified seed in the Alexandria district. Growers lost at least $15,000 by using this seed. Loss caused by this disease on Triumph variety all over the state from 25-75%. (Edgerton, August 1).

Arkansas: Always important. One hundred percent of fields in state infested, showing 5% affected plants. Reduction in yield for state 10%. It was first reported in June from Fayetteville, but later occurred all over the state. Bliss Triumph was very susceptible. (Elliott).

Indiana: A low percentage of the stand affected. Not considered a serious factor in Indiana. (Gardner).

Michigan: Probably, quite as usual. The mosaic in all early stock was easily overlooked because of the masking effect of the vigorous growth brought about by the season. In late Green Mountain potatoes, only one field was able to pass inspection, which permitted no more than 4% mosaic. (Coons).

Wisconsin: Triumph, most susceptible; Green Mountain, medium; Cobblers, Ohio, Burbank, and Peerless, slight; Rural New Yorker, little if any. Symptoms may have been masked by dry weather. Notably less aphis than usual this year, which seems important. (Vaughan).

Minnesota: Largely obscured by dry weather and leaf hopper injury. About as abundant as in previous years. (Department of Plant Pathology).

Iowa: More. Found in Early Ohio and Bliss Triumph. (Melhus).

North Dakota: This disease has not been pronounced in North Dakota this year. (Bolley).

Nebraska: Slight amount of mosaic in western potato sections. (Goss).

Kansas: Slight amount in plants from northern seed (Bliss Triumph). (Melchers).

Western States: Mosaic has now reached such a degree of prevalence throughout the Western states that, if neglected, neither reasonable yields nor any substantial progress in the seed improvement work can be expected. We have now definitely established that it reduces the yield in the West exactly in the same proportion as it does in the East, that is on the average by one-third. It is evident also that in a number of successive years the diseased plants are apt to go from bad to worse, especially under adverse seasonal or poor cultural conditions. We have no exact knowledge, however, as to the principal agencies transmitting this disease in the West. Likewise, we lack exact experimental data on which to base our recommendations for control, except what we have learned in the East. (Shapovalov).

Montana: Very common and widespread throughout the state. Innumerable "mild cases" appearing during early September and late August. Taken as indication of frequent transmission and rapid spread of the disease through mid-summer weeks. (Jennison).

Colorado: (Montrose section). Mosaic was noted, though no pronounced cases. (Shapovalov, News Notes, Office of Cotton, Truck, and Forage Crop Disease Investigations, Aug. 6, 1921, page 5.).

Utah: Especially severe throughout the state. Many fields exhibited as high as 50-60%. No fields were found free. Cache and Boxelder Counties appear to have suffered most severely from the trouble. It would be safe to state that Utah's crop was reduced from 15-25% from what appears to be the typical mosaic of the East. (Richards).

Idaho: Potato mosaic is becoming of increasing importance each year in Idaho. Especially bad in North Idaho this year. (Hungerford).

Common in southern part of state, varying from trace to 100%. Present in every field inspected. (Raeder).

Oregon: Apparently of considerable importance, coextensive with host; more than 90% in some fields. Observations this year show disease to be widespread and serious but extent of yield reduction not determined. (Barss).

California: Mosaic occurred in all districts south of San Francisco and Sacramento. All fields showed this disease in some degree. Owing to the association of other diseases it is difficult to estimate the effect on the crop. (Milbrath).

Losses from mosaic, 1921

Figures from New York inspections (Table 59) made available to the Plant Disease Survey through the courtesy of Barrus and Chupp (Cornell University) are here reproduced as illustrating typical conditions in the northeastern part of the country where mosaic was important in practically all fields, but where its symptoms were masked by weather and hopper-burn. The figures from the inspections in Nebraska are also of interest (Table 60).

Table 58. Estimated reduction in yield of potatoes due to mosaic, as reported by collaborators, 1921.

State	Estimated reduction in yield due to mosaic	State	Estimated reduction in yield due to mosaic
Vermont	5-10%	Arkansas	10%
New York	1.5%	Indiana	0.1%
New Jersey	5%	Michigan	t
Pennsylvania	1%	Wisconsin	t
Delaware	0.5%	South Dakota	t
Virginia	1%	Montana	10%
Kentucky	40% in early crop,	Utah	12%
	less in late	Idaho	3%
North Carolina	2%	Washington	15%
Louisiana	30%, very serious	Oregon	1%
Mississippi	15%	California	.5%
Texas	0.1%		

Table 59. Percentages of mosaic in potato fields inspected in New York during the summer of 1921.

County	Number of fields inspected	Acreage	Average percentage of mosaic
Allegany	18	59.00	4.50
Cayuga	17	54.50	2.12
Chenango	5	12.75	0.19
Clinton	9	42.50	2.11
Cortland	45	176.75	0.16
Erie	28	62.00	0.07
Essex	5	18.50	4.13
Franklin	48	188.01	3.38
Genesee	9	102.50	0.28
Livingston	7	37.50	0.92
Madison	3	6.00	Trace
Monroe	41	186.30	0.06
Niagara	4	6.75	0.00
Oneida	19	55.83	0.49
Onondaga	22	83.33	0.03
Ontario	15	64.16	0.36
Orleans	7	45.00	0.07
Oswego	8	25.00	0.80
Seneca	9	39.75	Trace
Steuben	10	53.50	0.95
Washington	75	170.15	1.73
Wayne	11	23.00	Trace
Wyoming	11	27.00	0.11
Total	426	1539.78	1.11

Table 60. Percentages of mosaic in potato fields inspected in Nebraska. 1921. (Goss and Werner).

County	Number of fields inspected	Acreage	Variety	Average percentage mosaic
Box Butte	14	469	Triumph	1.38
Dawes	18	213.5	Triumph	5.92
	4	16.5	Early Ohio	1.38
Kimball	3	40	Triumph	0.00
Scotts Bluff	1	10	McClure	t
Sioux	1	2	Downing	t
	4	56	Triumph	.75
Sheridan	1	7	Early Ohio	t
Total and average	46	814		2.92

Dates of first indications of potato mosaic, 1921

March....	Louisiana, Baton Rouge
May......	Mississippi, Crystal Springs
June.....	Arkansas, Fayetteville
June 4...	Oregon, Hillsboro
June 6.....	New York, Suffolk County
July 19....	Wisconsin, McNaughton
Sept. 27...	Delaware, Bridgeville

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Leafroll (cause undetermined)

Leafroll continued in 1921 to be a disease of major importance and the subject of considerable research. In the summary of their very important contribution to our knowledge of leafroll, Schultz and Folsom[2] make the following significant statements:

> "Leafroll is transmissible from one plant to another by means of grafting either tubers or stalks and by means of aphids.
>
> "Net-necrosis is apparently a leafroll symptom..... It develops in the dormant tubers without relation to differences in the storage temperature. When it occurs as a symptom of leafroll, the effects of the latter are still more detrimental, one being a decided spindliness of the sprouts. Transmission and control of leafroll are thus concerned indirectly with net-necrosis and spindling sprout.
>
> "Leafroll and mosaic are somewhat similar types of diseases.
>
> "Inter-regional differences in the spread of leafroll may depend upon differences in climate and in the abundance of aphids.
>
> "Roguing has proved to be more effective in eliminating leafroll than it has been for mosaic, at least in northeastern Maine."

The results of the investigations of Schultz and Folsom, in so far as they deal with the correlation of foliage degeneration and leafroll, have been supplemented by A. H. Gilbert[1] who presents confirmatory work.

> "(1) Tubers with spindling sprouts invariably produced either leafroll plants or plants possessing both mosaic and leafroll symptoms.
>
> "(2) Spindliness of sprout was often correlated also with net-necrosis. Eyes in or near necrotic tissue produced spindling sprouts, while other eyes from non-necrotic portions of the same tuber produced sprouts apparently normal. No disease-free plants, however, were secured from tubers either partially or entirely necrotic.
>
> "(3) Every net-necrosis tuber produced plants showing typical and advanced leafroll, but not all leafroll plants were from net-necrosis tubers.
>
> "(4) Well marked symptoms of both mosaic and leafroll occurring simultaneously in the same plant have been observed in a number of instances."

Blodgett of New York has continued his "indexing" system of testing potatoes. (See mosaic).

The importance of the disease in 1921 is shown by the estimates of yield reduction given in Table 61.

Table 61. Estimated reduction in yield of potatoes caused by leafroll, 1921, according to collaborators.

State	Estimated percentage reduction in yield	State	Estimated percentage reduction in yield
Vermont	5-10	North Carolina	5
New York	1 or more	Indiana	3
New Jersey	5	Montana	2
Pennsylvania	10	Idaho	Slight
Maryland	2	Washington	t
Virginia	1	Oregon	t
Kentucky	10	California	6
Tennessee	t		

The following comments from collaborators are of interest in reviewing the situation of various states:

Vermont: On the average a little more than last year. Common everywhere, showing greatest injury in July at time of blossoming; 25% of the fields infested with perhaps 25% affected plants per field. (Lutman).

Becoming increasingly prevalent in Vermont. (Gilbert).

New Hampshire: More abundant than last year. (Butler).

Massachusetts: Common on home-grown stock. (Osmun).

Rhode Island: None observed. (Browning).

Connecticut: More or less seen, but apparently of the dry weather type. (Clinton).

New York: Extremely dry weather here made it hard to distinguish leafroll. "Blue sprouts more heavily infested than white sprouts. (See Table 62 for results of inspections) (Chupp).

New Jersey: Slight trace on early crop, about 15% infection on the late crop. (Cook).

Pennsylvania: Very important. Reducing the yield in the state 10%. Field counts as high as 100% are frequent. (Thurston and Orton).

Kentucky: Leafroll was present in about the same percentage as last year and was a disease of considerable importance, occurring in 97% of the plantings with a percentage of 1 to 7%. I estimate the reduction in yield at 10%. (Valleau).

North Carolina: Common in the early Eastern Shore crop and also in the crop grown in the mountains. (Foster).

South Carolina: Unimportant. (Ludwig).

Mississippi: Not present to any extent in the state. (Neal).

Louisiana: Slight infection noticed in various parts of the state, but apparently of no economic importance as yet. (Edgerton).

Arkansas: Not observed. (Elliott).

Ohio: Our observation has been that with ordinary methods of handling a good stand of seed is badly run out by the third year.(Clayton).

Indiana: Serious feature in crop; not easy to detect. Of greenhouse tests, found in seed from nine counts, reducing yield 3%.(Gardner).

Michigan: Masked by hot weather effects. (Coons).

Wisconsin: A few cases of questionable identity. (Vaughan).

Minnesota: Probably the same as last year, not very important since very little was observed. Mostly obscured by hopper injury. (Department of Plant Pathology).

North Dakota: Not sufficiently pronounced to be specifically recognized. (Bolley).

South Dakota: Trace. (Evans).

Nebraska: Very slight. (Goss).

Kansas: No report. (Melchers).

Montana: Only occasional cases found in this state. (Jennison).

Colorado: Some leafroll reported in different sections, especially in the San Louis Valley. Extent of disease unknown. (Bureau of Crop Estimates report).

Utah: Leafroll is not clearly defined in Utah. (Richards).

Idaho: Fairly common; reducing yield slightly. (Hungerford).

Washington: Seen in two locations. (Dana).

Oregon: Prevalence unknown - no systematic survey. Probably more general than we have knowledge of. (Barss).

California: Very general throughout the state. All fields affected more or less. Losses ranging from 5-20% per field; in Los Angeles County, 30% injury. (Milbrath).

Table 62. Percentages of leafroll in potato fields inspected in New York during the summer of 1921.

County	No. of fields inspected	Acreage	Average percentage of leafroll	County	No. of fields inspected	Acreage	Average percentage of leafroll
Allegany	18	59.00	0.20	Niagara	4	6.75	1.14
Cayuga	17	54.50	0.42	Oneida	19	55.83	0.17
Chenango	5	12.75	1.76	Onondaga	22	83.33	1.13
Clinton	9	42.50	0.43	Ontario	15	64.16	Trace
Cortland	45	176.75	0.48	Orleans	7	45.00	2.02
Erie	28	62.00	0.55	Oswego	8	25.00	0.05
Essex	5	18.50	0.11	Seneca	9	39.75	0.17
Franklin	48	188.01	0.33	Steuben	10	53.50	0.46
Genesee	9	102.50	0.15	Washington	75	170.15	0.09
Livingston	7	37.50	0.92	Wayne	11	23.00	0.20
Madison	3	6.00	Trace	Wyoming	11	27.00	0.12
Monroe	41	186.30	0.55	Total	426	1539.78	0.43

Table 62 detailing results of field inspections is given to illustrate general field conditions in New York state. Although the figures are not high, leafroll being hard to detect, they throw light on the magnitude of the leafroll problem in northeastern United States, since these fields were for the most part grown from certified seed of 1920 and represent the conditions in standard certified lots of seed.

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Foëx, Et. Les relations entre la leptonecrosse et l'enroulement. (The relations between leptonecrosis and leafroll). Bul. Soc. Path. Veg. France 8: 24-28. 1921. (Abstract by C. L. Shear in Bot. Absts. 10: Entry 660. 1922.

Tipburn (non-parasitic) and hopperburn induced by leafhoppers (Empoasca mali)

Tipburn and hopperburn were probably the most important troubles of potatoes last year and in the aggregate caused enormous money loss to growers. Entomological reports confirming the original work of Ball and his associates as to the etiology of hopperburn have come in increasing numbers. On the

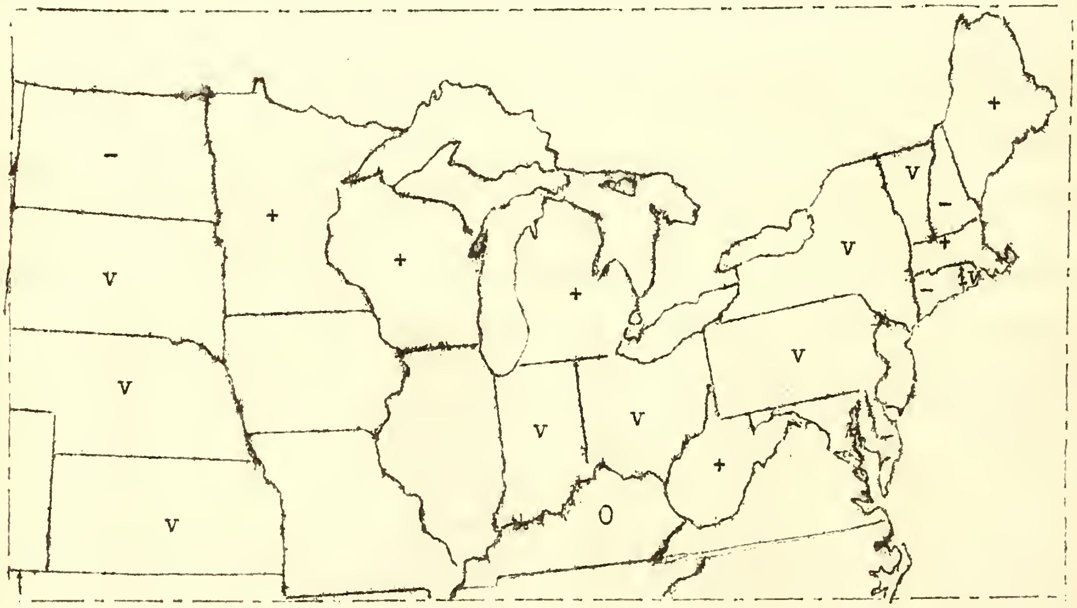


Fig. 72. Importance of tipburn and hopperburn in 1921.

other hand, Lutman[5] maintains that there is a distinct trouble called tipburn associated with death of the marginal vein, due to loss of water and indicated by a browning of the entire region. The report from Bolley of North Dakota quoted below is interesting in this connection. Folsom and Schultz[3] confirm the position of Lutman, in stating that in Maine in 1921, the hopperburn type of tipburn was not seen. Comparative studies should be made and the facts ascertained for each state in order to determine the relative importance of these two troubles. In this discussion, no attempt is made to decide the type of tipburn the collaborator is reporting, but comment is freely quoted from the various states.

The importance of tipburn in 1921 is indicated in Table 63 and on the map (Fig. 72), and by the reports from collaborators quoted below.

Table 63. Losses from tipburn and hopperburn of potato, 1921.

State	Loss	State	Loss
Maine	Severe	North Carolina	2% severe hopperburn observed. (Shapovalov)
Vermont	5-10%	Mississippi	Trace
New Hampshire	Prevalent	Ohio	Widespread and severe
Massachusetts	Serious and general	Indiana	4%
Rhode Island	Very common	Michigan	15-20%
Connecticut	Less than average year	Wisconsin	10% (moderate)
New York	5-10%	Minnesota	10%
Pennsylvania	8%	North Dakota	Unimportant
West Virginia	25%, worst trouble	South Dakota	5%
Kentucky	Usually important	Nebraska	Considerable
Tennessee	Fairly destructive in East Tennessee	Kansas	Quite severe
		Montana	More common
		Idaho	Less important

Quebec: Hopperburn occurs periodically whenever dry conditions prevail in potato growing areas. Has been very prevalent in Quebec (1921) and caused considerable loss. Irish Cobbler is more susceptible than Green Mountain. (B. T. Dickson[1]).

Vermont: Tipburn of physiological cause was much more prevalent in 1921, being the most important potato disease of the year and reducing the yield for the state 5-10%. The trouble was purely physiological, there being practically no hoppers. First seen July 6 at Burlington, doing greatest injury July 25. (Lutman).

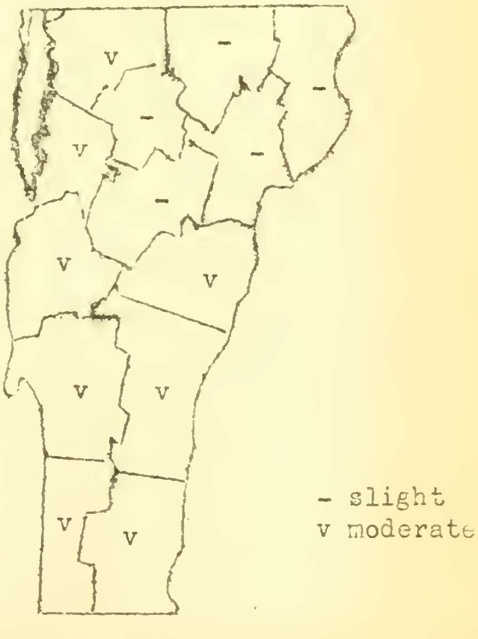


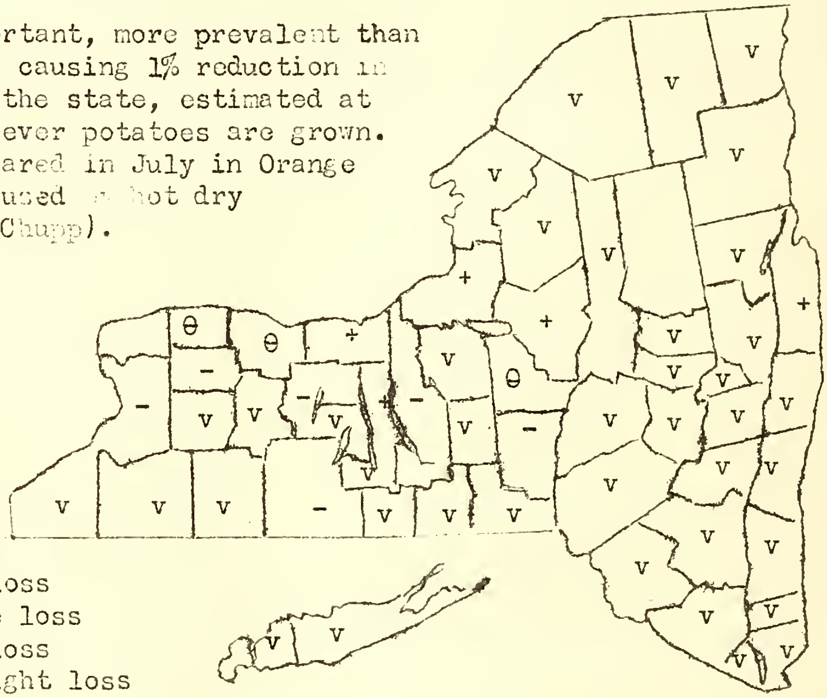
Fig. 73. Occurrence of tipburn in Vermont, 1921. (Lutman).

Massachusetts: General on early

varieties in unsprayed fields. Green Mountain not seriously affected. Dibble's Russet practically not at all. (Osmun).

Connecticut: Next to prematuring, tipburn has been the most conspicuous potato trouble of the year. Due to quite variable weather rainy days followed by bright hot ones and unusual hot weather as a whole. (Clinton).

New York: Important, more prevalent than last year, causing 1% reduction in yield for the state, estimated at 5-10% wherever potatoes are grown. First appeared in July in Orange County, caused by hot dry weather. (Chupp).



+ severe loss
v moderate loss
- slight loss
θ very slight loss

Fig. 74. Tipburn and hopperburn of potatoes in New York, 1921. (Chupp).

Table 64. Percentages of tipburn in potato fields inspected in New York during the summer of 1921.

County	No. of fields inspected	Acreage	Average percentage of tipburn	County	No. of fields inspected	Acreage	Average percentage of tipburn
Allegany	18	59.00	5.00	Niagara	4	6.75	0.01
Cayuga	17	54.50	6.88	Oneida	19	55.83	20.64
Chenango	5	12.75	3.92	Onondaga	22	83.33	14.40
Clinton	9	42.50	6.59	Ontario	15	64.16	1.12
Cortland	45	176.75	9.60	Orleans	7	45.00	0.09
Erie	28	62.00	4.81	Oswego	8	25.00	50.00
Essex	5	18.50	5.14	Seneca	9	39.75	19.62
Franklin	48	188.01	10.89	Steuben	10	53.50	1.69
Genesee	9	102.50	1.96	Washington	75	170.15	18.72
Livingston	7	37.50	6.72	Wayne	11	23.00	26.30
Madison	3	6.00	0.01	Wyoming	11	27.00	16.00
Monroe	41	186.30	10.31		426	1539.78	10.57

Pennsylvania: More important than usual, causing 8% reduction in yield for the state, being very severe in the southeastern section on unsprayed fields, due to drouth. (Thurston and Orton).

Maryland: Trace. (Jehle and Temple).

West Virginia: More prevalent than usual, being the worst potato trouble in nearly all localities, causing a 25% reduction in yield for the state. Particularly severe in early varieties in the Ohio Valley and lower altitudes. A few localities in the higher altitudes not seriously affected. (Giddings).

Kentucky: This disease is usually important, but flea beetle injury was so severe this year that the injury from hopperburn could hardly be recognized. (Valleau).

Ohio: Tipburn is causing more damage at present than any other trouble. Between drouth and tipburn, the crops in central and southern Ohio have been practically a failure. In northern Ohio the early potatoes have suffered severely, but the trouble is not yet prevalent on the late crops. Leaf hoppers, which transmit this trouble, are very abundant in the fields of late potatoes. (Clayton).

Indiana: Less prevalent than usual, causing a 4% reduction in yield. A serious factor all over the state in the early crop, causing foliage reduction and premature death. The hot weather of June and July favored the disease. (Gardner).

Michigan: Experiments conducted at the Upper Peninsula Sub-station, Chatham, during the 1919 and 1920 seasons, as well as at other State experiment stations, have proved conclusively that the potato leaf hopper is the cause of the injury. The importance of the potato leaf hopper as a potato pest was demonstrated in a favorable season such as in 1919, when the potato vines in many sections of the state were killed as early as the latter part of July before the tubers had reached marketable size. As a consequence, a great many growers suffered an entire loss of the crop. The loss to the Upper Peninsula potato growers in 1919 from this injury alone was estimated at $1,000,000....... The overwintering adults and the nymphs of the first generation are of primary importance in the control of hopperburn for they give rise to the destructive second generation. The destruction of the adult potato leaf hopper is very difficult, but it can easily be repelled by applying some kind of covering to the potato vines which the leaf hopper does not like. Bordeaux mixture 5-5-50 serves this purpose very well and at the same time controls other diseases which attack the potato leaves. Bordeaux mixture should be applied from underneath so as to cover the under side of the leaves, as it is here that the adults lay their eggs and the nymphs feed. At least four applications should be made during the growing season. The first application should be made when the vines are from three to six inches tall, this to be followed about a week later by a second spraying. The subsequent applications should be made at intervals of 10-14 days. The first two sprayings will repel the over-wintering adults, while the later sprayings will ward off the adults of the first generation which come to potato fields to lay egg for the second generation. (Kotila4).

Fifteen to twenty percent loss. (Coons).

Wisconsin: More prevalent than usual, being most severe in the central and southern parts of the state, causing a 10% reduction in yield. First appeared June 25 at Madison, doing greatest injury during the hot, dry period from July 1 to August 25. Triumph and Ohio were highly susceptible. Green Mountain medium, and Rural New Yorker resistant. (Vaughan).

Minnesota: Very important, most serious disease of potato, being much more prevalent than usual, and causing a 10% reduction in yield for the state. (Section of Plant Pathology).

Iowa: Fifteen percent reduction in yield. (Melhus).

North Dakota: Tipburn rather common. In association with heat during late June and early July, appeared to result in a good deal of destruction. Do not think there is any indication that this disease is particularly associated with the attack of leaf hoppers. No doubt these insects increase the destruction. It seems to be wholly associated with some root trouble which causes the plants to fail to furnish sufficient water to meet the transpiration taking place on the marginal points of the leaf and particularly from the water pores. It is naturally pronounced in its destruction at times when transpiration is excessive and moisture is deficient. (Bolley).

South Dakota: Very important, causing a 5% reduction in yield for the state. Scarcely a field is without it. (Evans).

Montana: More commonly seen than last year, especially during the latter part of the summer when weather was hot and dry. (Jennison).

Fenton and Ressler[2] have produced a tipburn artificially with injections of emulsions made from adult leaf hoppers. They suggest that Bordeaux mixture does not prevent tipburn by its action on the leaf, but rather by its action on the insect.

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Anthracnose caused by Colletotrichum atramentarium (Berk & Br.) Taub.

Anthracnose was reported from two states this year - Ohio and West Virginia. It was less prevalent than last year in Ohio where it was first found October 21 in Geauga County, and was of slight importance. For West Virginia, Giddings, on August 29, reported anthracnose causing quite a little injury in one field near Morgantown. He says, "There is no doubt in my mind from all the evidence secured in the laboratory as well as in the field that the Colletotrichum was the cause of the injury in this case. I cultured the fungus from lesions on the live stalk and secured practically pure cultures in every case."

Tuber rots caused by Fusarium spp.

This type of trouble, showing chiefly as a rot of the stored product, is, in the aggregate, as shown by the market inspection reports (Table 65) a source of enormous loss. Reports in general need to be interpreted in the light of conditions at time of shipment, and with reference to the part of the country from which shipments arise. In general it may be said that western grown potatoes, due perhaps to sweating in cars and to particular pathogens, are seriously injured during their long transit, while eastern grown stock is prone to rot in shipment or storage only if the tubers are bruised or wounded or if ventilation is neglected. The figures for the Michigan 1920 crop are complicated by the existence of much injury from "field frost" which passed rapidly into Fusarium decay or into slimy soft rot. (Contrast 1920 figures for Michigan with 1921 figures.) In the main, the figures but serve to show the existence of problems peculiar to sections, and of problems in crop handling and transportation deserving of continued work.

Table 65. Losses from Fusarium tuber rot caused by Fusarium spp., as shown by examination of cars at destination by inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	Range of dates of inspection	Number of cars with decay	Average percentage of decay	Range of percentage of decay	
				No. cars	Percent
		1920 CROP			
Colorado	Jan. 6-April 13	16	4	4	6-13
				12	2-4

Origin of shipment	Range of dates of inspection	Number of cars with decay	Average percentage of decay	Range of percentage of decay	
				No. cars	Percent
Delaware	April 9 - May 14	2	2	2	2
Idaho	Mar. 7 - April 30	3	3	3	2-4
Illinois	Febr. 24-28	3	3	3	1-6
Kansas	Mar. 14	1	5	1	5
Maine	Jan. 5 - July 21	65	6	3	27-47
				13	5-20
				49	2-4
Maryland	Mar. 17-21	2	4	2	2-6
Michigan	Jan. 4 - July 21	129	3	2	25-30*
				13	5-17*
				114	1-4
Minnesota	Jan. 3 - June 3	130	4	31	5-15
				99	1-4
Montana	Mar. 28 - May 24	5	3	5	2-5
Nebraska	Jan. 10 - Mar. 17	11	10	7	5-20
				4	2-4
New Jersey	Jan. 4 - Mar. 16	2	4	2	3-5
New York	Jan. 6 - July 6	114	4	32	5-20
				82	1-4
North Dakota	Jan. 3 - Mar. 26	10	4	3	5-10
				7	2-4
Oregon	Mar. 2 - April 21	2	4	2	3-5
Pennsylvania	Mar. 11 - May 2	9	7	7	5-14
				2	2-4
Washington	April 29	1	15	1	15
Wisconsin	Jan. 5 - June 13	55	3	7	5-12
				48	1-4
Wyoming	Febr. 1	1	4	1	4
Canada	Febr. 3 - June 2	21	3	21	1-6
Unknown	Jan. 4 - June 22	63	4	1	35
				6	6-13
				56	1-4
Total........................		645			
		1921 CROP			
Alabama	June 10	1	9	1	9
California	July 22 - Nov. 11	7	2	7	2#
Colorado	Aug. 22 - Dec. 1	28	9	4	27-35#
				8	5-18
				16	2-4
Delaware	Aug. 4-29	8	9	3	10-33
				6	3
Florida	Apr. 5 - May 9	11	4	4	5-7
				7	2-3
Georgia	June 6 - July 13	4	3	4	2-5
Idaho	Aug. 24 - Dec. 7	13	6	1	35
				3	7-8
				9	2-4
Indiana	Sept. 3	1	2	1	2

Origin of shipment	Range of dates of inspection	Number of cars with decay	Average percentage of decay	Range of percentage of decay	
				No. cars	Percent
Kentucky	July 12	1	27	1	27
Louisiana	May 17 - Oct. 7	21	5	1	40*
				2	5-10
				18	2-4
Maine	July 21 - Dec. 2	51	4	11	5-22
				40	2-4
Maryland	July 5 - Aug. 10	26	4	5	6-13
				21	1-4
Massachusetts	Aug. 18	1	12	1	12
Michigan	Sept. 23 - Dec.13	21	2	21	1-5
Minnesota	Aug. 27 - Dec. 13	55	5	1	65
				12	5-23
				42	1-4
Montana	Sept. 26 - Dec. 7	23	4	5	5-10
				18	1-4
Nebraska	July 25 - Nov.22	14	14	2	55-65
				2	20-25
				10	2-5
New Jersey	July 18 - Dec. 8	123	7	24	12-35*
				33	5-10
				66	1-4
New York	Aug. 20 - Dec. 8	51	2	3	5-10
				48	1-4
North Carolina	June 11 - July 19	33	10	5	30-43*
				10	5-18
				18	1-4
North Dakota	Nov. 19 - Dec. 9	4	3	4	2-4
Ohio	Oct. 10	1	4	1	4
Oklahoma	July 14	1	83	1	83*
Pennsylvania	Aug. 17 - Nov. 21	2	4	2	4
South Carolina	May 27 - June 3	17	6	5	8-27
				12	1-4
South Dakota	Nov. 1	1	2	1	2
Texas	May 10	1	6	1	6
Utah	Aug. 17 - Oct. 27	7	4	7	2-8
Virginia	Apr. 29 - Aug.22	170	7	4	55-85*
				13	15-45
				42	5-13
				111	1-4
Washington	Dec. 8	1	6	1	6
Wisconsin	Oct. 20 - Dec. 15	6	3	6	2-5
Canada	Oct. 31 - Nov. 26	4	2	4	2-3
Unknown	July 7 - Dec. 13	52	7	2	55-65
				3	25-27
				10	5-10
				37	1-4
Total........................		760			

Total number cars of potatoes inspected (calendar year 1921) 6,035

* Associated with slimy soft rot. # Associated with leak.

Recent literature

Goss, R. W. Temperature and humidity studies of some Fusaria rots of the Irish potato. Jour. Agr. Res. 22: 65-79. Pl. 10-11. Oct. 8, 1921.

Jelly end rot, probably caused by Fusarium sp.

Western States: Jelly rot is a persistant and very annoying trouble in the irrigated sections, associated with the long-shape varieties, such as Burbank and Netted Gem. As the writer has pointed out on several other occasions, this trouble presents a great deal more complicated condition than if it were merely Fusarium stem-end rot. Moreover, certain preliminary cultural work of the last two seasons tends to indicate that the true jelly decay may not at all be due to Fusarium. How and why this trouble came about and how it may be prevented - for these questions we have no answer at present. (Shapovalov).

Idaho: Unimportant, occurring in isolated cases. (Raeder).

Jelly end rot is affecting the Gems rather more than in southern Idaho owing to the fact that there is a large percentage of stock that is very much pointed at the stem end. Of course, this difficulty or disease only affects the off-shape tubers. (E. R. Bennett, Boise).

Washington: Occurred in Yakima County. (Dana).

Leak caused by Pythium debaryanum Hesse or Rhizopus nigricans Ehr.

The following summary of the market situation with reference to leak by G. K. K. Link[1] is important:

> "Field and market observations made during the past few years seem to indicate that leak is virtually coextensive with the potato crop of the United States, and that it is a serious transit and storage disease. In the terminal markets it has been noted in potatoes from New Jersey, New York, North Carolina, Louisiana, California, Washington, Idaho, Montana, Wyoming, Colorado, Nebraska, and Minnesota. The heaviest losses have been observed in Rurals shipped out of Idaho during the hot weather of August and September. The disease seems to occur in potatoes from other sections if the crop is dug and moved during warm weather. Potato men are reluctant to store early potatoes because 'they do not keep'. One of the reasons for this situation is the manace of leak in both early and late potatoes if dug and stored during warm weather. During September and October of 1921, the losses in Rurals and Burbanks in Idaho storage houses were heavy. It has been demonstrated by isolations and inoculations that most cases of leak are caused by Pythium-like fungi. During the four years only four cases of leak due to Rhizopus spp. and two due to Mucor spp. were found. Leak has been produced experimentally with the Rhizopus species, but not with the species of Mucor."

Other collaborators report as follows:

Ohio: Leak (Rhizopus nigricans), one report only, October 11, in Cuyahoga County, as a storage rot. (Detmers).

Idaho: Important in mid-season potatoes. (Hungerford).
I have found one or two cases since digging time of what I pronounced as leak, although I did not make cultures. (Bennett).

Washington: Two reports for 1921. (Dana).

Literature cited

1. Link, Geo. K. K. Leak, a serious transit disease of potatoes. (Abstract) Phytopath. 12: 38. Jan. 1922.

Germination troubles due to various factors

Germination trouble was reported from a number of states including Maine, Virginia, North and South Carolina, Texas, Ohio, Indiana, Michigan, Wisconsin, and Colorado. The poor condition of seed potatoes in storage and especially the weather at planting time are responsible for the severe losses reported. The trouble was complicated by attack on seed pieces by the seed corn maggot (Pegomyia fuscipes) in some states, but in general it was due either to mere failure to germinate or to rotting of the seed pieces by Fusarium. Probably in the southern Coastal states the extremely hot weather of March was very significant in leading to excessive rotting.

In addition to the reports previously published (Pl. Dis. Bul. 5: 17-18, 53. July 1 and August 1, 1921), the following comments from collaborators give the facts for the various areas:

Maine: The extreme southern part of Aroostook County, and the rest of the state on an average in a worse degree, has been badly hit by the drouth. A part of this effect showed itself in misses and failure to germinate. I have seen numerous cases in southern and central Maine where the stands are very poor. (Morse).

Virginia: Combination of high air temperature and low soil moisture producing unusually high soil temperatures during planting season. (Fromme).
The condition of many potato fields in the Norfolk and Eastern Shore sections is very serious and discouraging. While there are some perfect fields or portions of fields (for instance in central and northern sections of Northampton County), 15% of missing hills is very common, even 25 to 30% of loss is frequent and in a certain number of cases it reaches 50 to 60%, being in exceptional cases as high as 75%. Fields showing from 50 to 75% of damage are regarded as unprofitable and are being plowed and planted over again. (Shapovalov).

North Carolina: (May 24) For the past two weeks I have divided my time between several of the mountain counties and those along the eastern coast. It is a little too early to see much in the mountain section as the potatoes are just coming out of the soil. They have not had the potato germination trouble, however, and in all sections the stand is practically perfect. The weather has been very unfavorable to crops in eastern Carolina. The rains accompanied by cool days and nights have necessitated the replanting of cotton, corn, and melons several times with distressing results so far. A lot of the potatoes are rotting in the soil, some of it being caused by the blackleg organism, some by the constant dampness of the soil, and possibly some by the prevalence of a number of the physiological diseases, such as mosaic and leaf curl, which caused weakened plants. (Foster).

South Carolina: Germination troubles were more prevalent and more important than usual this year, especially in the lower part of the state where growers failed to obtain stands. The trouble was first noticed at Ladson on March 9, and was probably caused by the hot dry season. (Ludwig).

Indiana: Extreme heat the latter part of June caused germination trouble to be much worse than usual in the late crop in central Indiana. In 50% of the fields 25% of the plants were affected, causing a 20% reduction in yield, some growers suffering almost total loss. Excessive rains, as well as extreme heat, may have had some effect. (Gardner).

Michigan: Poor stand, especially in northern half of Lower Peninsula. Potatoes commonly replanted because of failure. Whole fields commonly replanted because of failure. Whole potatoes used for seed showed marked superiority. In large part, trouble due to hot soil conditions, but poor storage conditions had weakened many tubers. (Coons).

Colorado: Around Greeley there is considerable variation in the condition of things. The late planted potatoes look very poor. The trouble is due solely to the rotting of the seed piece, as I have described many times. (MacMillan).

Quotations from special reports by Fromme and by Shapovalov concerning the Virginia conditions are to be found in the Plant Disease Bulletin 5: 17-18. 1921. Shapovalov isolated Fusarium oxysporum, F. coeruleum, and F. radicicola from decaying seed pieces. The following statement regarding the temperature relations of these three fungi, is taken from Shapovalov's report:

> "It is interesting to note that F. radicicola and F. oxysporum thrive best at high temperatures, while F. coeruleum gives best growth at moderate temperature. It shows, therefore, that different contributing environmental factors mentioned in the report varied in their importance in various localities. It is probable that in the case of F. oxysporum and F. radicicola the high temperature which prevailed during the first part of March was of prime importance in bringing about the decay, while in the case of F. coeruleum very

likely winter storage of seed potatoes facilitated the development of incipient stages of rot which progressed to alarming proportions after planting."

New or little known diseases

Leaf hopper injury (not hopperburn) was reported by J. G. Leach[2] from Minnesota as follows:

> "During the summer of 1921 a hitherto undescribed pathological condition of the potato plant was observed in Minnesota. Affected plants were characterized by a pronounced shortening of the leaf petioles, with the consequent crowding of the leaflets. The petioles and mid-veins of the leaflets also were much shorter than normal and the tips curved sharply downward and backward towards the petiole. At the same time, the margins of the leaflets were folded upward along the mid-vein. The potato leaf hopper (Empoasca mali) was very abundant and was constantly associated with the disease. By placing a number of the insects collected from affected plants on normal, healthy plants grown under cages, it was proved experimentally that the leaf hoppers were responsible for the disease. All plants so treated developed typical symptoms within seven days, while all check plants remained normal. Sufficient data have not been obtained to justify conclusions as to the nature of the disease and its relation to hopperburn cuased by the same insect. The condition was very prevalent in Minnesota in 1921 and was undoubtedly responsible for considerable reduction in yield."

> "Bliss Triumph, Green Mountain, Irish Cobbler, and Early Ohio are susceptible in the order mentioned." (Supplemental report from Leach).

Yellow dwarf (cause undetermined) was reported from New York by Barrus and Chupp as follows:

> "A hitherto undescribed disease of potatoes, called 'Yellow dwarf' because of its effect on the vines, has been observed in New York State.

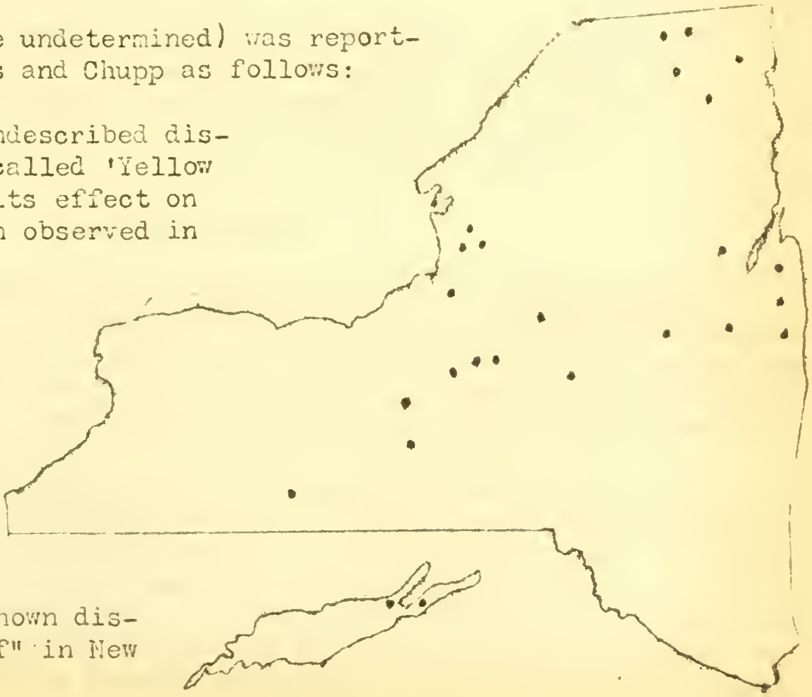


Fig. 75. Present known distribution of "yellow dwarf" in New York, according to Chupp.

Not only are affected plants dwarfed and the foliage yellowed, but there is a necrosis of the pith and cortical cells in the vicinity of the upper nodes of the stalk. Death of affected stalks takes place from the top downward, beginning with terminal and upper axillary shoots. Tubers from affected plants are usually small, irregular, more or less sessile, brittle, and often badly cracked. There is considerable internal discoloration in the form of rusty brown specks throughout the outer medullary tissue, often extending to the bud end but rarely to the stem end of the tuber. The number of discolored areas increases with the age of the tuber. A dry rot from the stem end, which finally involves the entire tuber, occurs on badly affected tubers. Even those otherwise apparently healthy can be detected by the more prominent lenticels. The disease affects at least eighteen varieties of potatoes and no variety has been found resistant. The agency causing the disease has not been determined. Infection evidently takes place from the soil and from infected tubers capable of producing plants."

Russet dwarf (cause unknown) was less prevalent in Idaho than in previous years. In this disease the plants are stunted; lower leaves turn brown and drop; vascular portion of stems and leaves turn brown; general russetting of leaves or entire plant late in season occurs. (Hungerford). Percentage of infection varied from a trace to 35%. (Raeder).

Chlorosis (non-parasitic) was reported from Colorado, Idaho, and Washington. Idaho (Hungerford) - Chlorotic condition reduces yield somewhat in irrigated fields in southern Idaho. Colorado (Shapovalov) - Calico was quite omnipresent. Washington (Dana) - Three reports.

Literature cited

1. Barrus, M. F. and Charles Chupp. Yellow dwarf of potatoes. (Abstract) Phytopath. 12: 39. Jan. 1922.
2. Leach, J. G. Leaf hopper injury of potatoes. (Abstract) Phytopath. 12: 37. Jan. 1922.

Other diseases

Leaf blotch caused by Cercospora concors (Casp.) Sacc., typically a disease of cool moist areas, was reported only from West Virginia (Giddings). The disease was quite prevalent in a few gardens and was evidently the cause of considerable injury. The badly affected leaves dropped off very easily and there were very few leaves left near the tops of the plants.

Black heart (non parasitic). The general loss from black heart seemed far less in 1921 than in 1920. No cars containing it being called to the attention of market inspectors from January 1, 1921 to July 1, 1921. No doubt this can be attributed to better shipping practices and the mild winter. On the other hand, the mild winter lead to poor keeping quality in the stored product and seed planted in 1921 was in general of low vitality. This factor, along with weather and soil conditions served to give the extremely poor stands in many states.

The following comments are of interest:

New York: Observed in poor storage houses and where potatoes are shipped in car with stove. (Chupp).

Michigan: Important losses in storage due to poor ventilation in pits and warehouse bins. Poor stand in part due to seed of low vitality. (Coons).

North Dakota: Unimportant. (Couey).

Washington: Five cases. (Dana).

Heat necrosis of unknown cause was reported from California (Milbrath) from spring crop fields in southern California. The loss for the state was given as .5%, but as much as 60% was observed in one field.

DISEASES OF TOMATO

Leaf spot caused by *Septoria lycopersici* Speg.

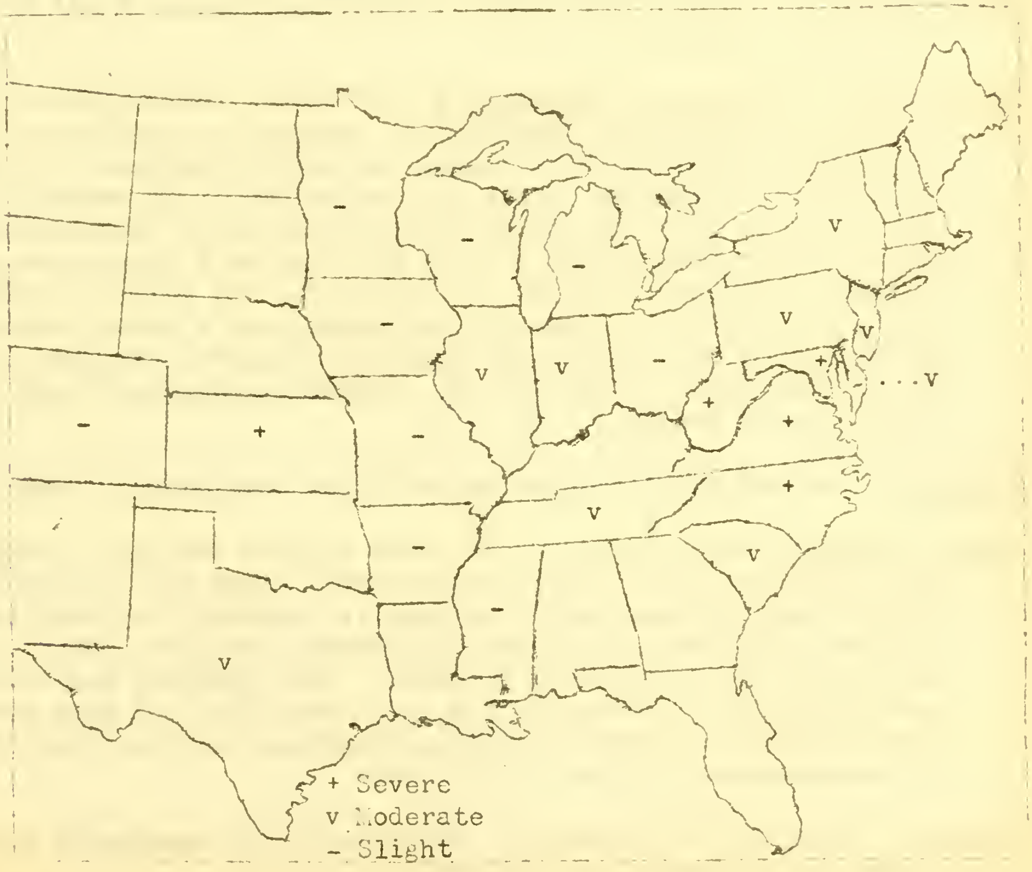


Fig. 76. Importance of Septoria leaf spot of tomato, 1921.

The Survey records contain reports of this disease from every state in the Union except Oregon, Montana, Idaho, Wyoming, Nevada, Utah, Arizona, and New Mexico. The disease was reported from practically the entire range last year and was said to be severe in Maryland, Virginia, West Virginia, North Carolina, and Kansas.

Table 66. Estimated percentages loss from tomato leaf spot, 1921

State	Percent loss	State	Percent loss
New York	3	North Carolina	10
Pennsylvania	1-2	Texas	3
Maryland	25	Indiana	5
Virginia	30*	Iowa	2
West Virginia	25	Kansas	10

*General and severe as usual.

The following comments are of interest. (For others see Pl. Dis. Bul. 5: 81, 116. Sept. 1 and Oct. 1, 1921.)

United States (General): Septoria lycopersici frequently kills the blossoms but I doubt that it causes much if any shedding of the fruit. (F. J. Pritchard).

Pennsylvania: Serious stem injury at about the time of fruit maturity. (Orton and Thurston).

New Jersey: The Septoria lycopersici leaf blight caused much injury to early and so-called second early tomatoes in New Jersey during 1921. Infection was irregular in many localities. In some fields the plants were defoliated before the fruit matured, causing premature ripening and shedding of fruit. A tomato field was examined near Haddonfield on July 28, - at this time there was no Septoria leaf blight found. By August 16, the leaves of the same plants were 100% infected by this fungus, and a large percentage of the leaves had fallen. Satisfactory progress was made in controlling the disease with wet Bordeaux sprays, and dust treatment. (R. F. Poole).

Delaware: Serious locally where rainfall has been heavy. (Adams).

West Virginia: More prevalent than usual or than last year; affected every plant in every field in the state; loss 25%. Caused destruction of leaves and stem injury. General, but most severe in lower altitudes of central and eastern sections. Worst during August, when fruit was ripening. Less moisture than usual, unusually hot. Bordeaux 5-5-50 with rosin fish oil soap gave good control and increased yield, amounting to from 50 to 200% in demonstration patches. (Giddings).

Indiana: Spraying not practiced; defoliation and consequent sunscald caused the greatest loss. (Gardner).

Dates of first appearance of tomato leaf spot, 1921

May 21... Wood County, W. Va.
May 29... Tompkins, N. Y.
(Probably carried from greenhouse or seed)
June 1... Lake County, Ind.
June 14.. Hazelhurst, Miss.
July 10.... New Jersey
July 23.... Harrison County, Ohio.
August 10.. Delaware
August 23.. Windsor, Conn.
August..... Fort Collins, Colo.

Weather relations

The leaf spot disease is known in general to be favored by wet seasons. The relation of rains to spore dissemination is obvious. Comparison of the rainfall maps for July and August shows some coincidence of areas of most severe loss and those of heaviest rainfall, but in each case the facts must be viewed with regard to the type of crop grown - whether early or late canners is concerned, etc. The agreement in reports from Wisconsin, Michigan, and Minnesota as to its lessened importance during 1921 presents also confirmatory evidence of the close relationship between the development of this disease and weather conditions, but close study in a limited region will probably be necessary to determine definite correlations.

Control of Septoria leaf spot

The following statement by F. J. Pritchard of the Office of Cotton, Truck, and Forage Crop Disease Investigations, summarizes American conditions with regard to the control of this disease:

> "Spraying tomatoes is practiced to some extent, but not generally. The cost of the spray outfit, the uncertainty of the results because of the impossibility of spraying during prolonged periods of wet weather, and the large amount of labor and team work involved when men and teams are most needed are the chief causes of so little spraying.
>
> "Very little dusting of tomatoes has been done, as dusts have not, as a rule, seemed to be so effective as sprays. However, the use of dusts needs further investigation, for, if effective dusting can be done it will appeal to the grower much more strongly than spraying. Considerable areas can be dusted with a relatively cheap outfit and with relatively little labor and team work as compared to spraying."

Recent literature

Pritchard, F. J. and W. B. Clark. Effect of copper soap and Bordeaux soap spray mixture on control of tomato leaf spot. Phytopath. 9: 554-564. 1919.

Pritchard, F. J. and W. S. Porte. Use of copper soap dust as a fungicide. Phytopath. 11: 229-235. 1921.

______________ Relation of horse nettle (*Solanum carolinense*) to leaf spot of tomato (*Septoria lycopersici*). Jour. Agr. Res. 21: 501-505. Pl. 95-99. 1921.

______________ Effect of fertilizers and lime on control of tomato leaf spot (*Septoria lycopersici*). Phytopath. 11: 433-445. Nov. 1921 (Feb. 1922).

Smith, L. B. and H. H. Zimmerley. Relation of pressure to effectiveness in spraying tomatoes. Virginia (Norfolk) Truck Exp. Sta. Bul. 33/34: 163-190. 1921.

Fusarium wilt caused by Fusarium lycopersici Sacc.

This disease which is most common and most serious in the southern part of the country, has occasionally been reported to the Plant Disease Survey from states as far north as New Hampshire, Massachusetts, Michigan, and Iowa. Somewhere along the line from southern New Hampshire westward is the "tension zone" for this species. With the extremely early seasons of the past year and the high soil temperature prevailing - the latter factor being conceived to be the chief determinant in the occurrence of this disease - it was to be expected that the northern range would be extended, and also that the disease would be more severe than usual during 1921. The following comments from collaborators are important in this connection (For other reports, see Pl. Dis. Bul. 5: 54, 81, 116-117. 1921).

New Jersey: The Fusarium wilt of tomatoes is not widely distributed in New Jersey. It is severe in localities in Gloucester, Burlington, and Camden Counties. There was a 65% loss of large plants of the Stone variety in one two-acre field in Camden County. The infected areas appear to be isolated in both localities and fields where the disease was observed. (R. F. Poole).

Georgia: Wilt was very serious. (McClintock).

Arkansas: Fusarium wilt of tomato was unusually severe even in supposedly resistant varieties. (Elliott).

Ohio: The long,hot, dry period has especially favored the development of the fungus responsible for the wilt disease of tomato; losses were serious in both early and late varieties. (Thomas).

Indiana: Hot early summer (May, June, and July) increased the severity of tomato Fusarium wilt. (Gardner).

Michigan: Present in considerable amount in a field in southeastern Michigan. (Coons).

Iowa: More than last year or the average year. Serious in isolated localities. (Melhus).

Kansas: More than last year. The loss caused by this disease has been increasing from a trace up to 5% now. As much as 100% infection in some fields. This disease is becoming worse and more widespread. (Melchers).

Montana: Fusarium wilt of tomatoes found. (Jennison).

Table 67. Estimated losses from Fusarium lycopersici on tomato, as reported by collaborators, 1921.

State	Percent loss	State	Percent loss
Pennsylvania	1-2	Louisiana	25
Maryland	5	Texas	5
Virginia	30	Arkansas	10
Kentucky	33	Ohio	15
North Carolina	6	Indiana	3
South Carolina	3	Kansas	5

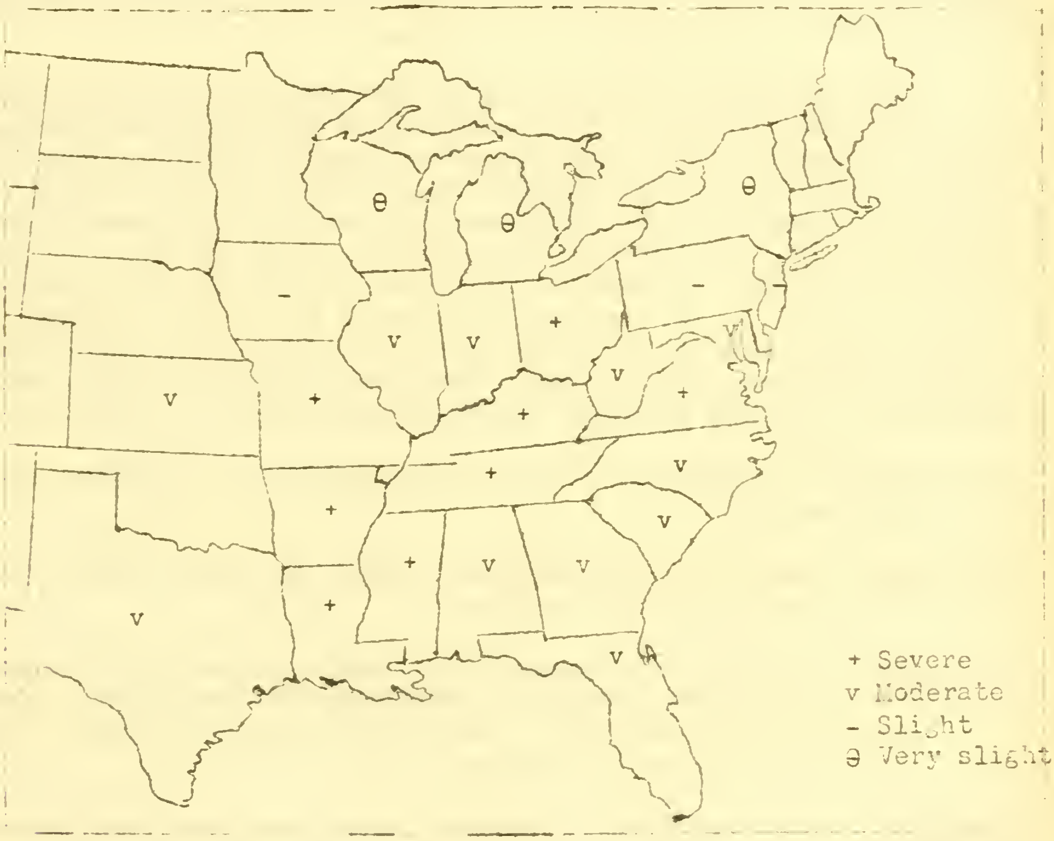


Fig. 77. Distribution and importance of Fusarium wilt of tomato, 1921.

Dates of first appearance of wilt, 1921.

May 21... Wood County, W. Va.
May 25... Utica, Miss.
June..... Wayne County, Ohio.
June 27... Clemson College, S. C.
July 15... Newark, Del.

Observations by Gardner show the importance of southern grown seedlings in introducing the wilt organism. Every spring thousands of seedlings are shipped north and soil infestation with the root knot nematode and with fungous diseases results.

Indiana: In the canning crop wilt was confined largely to southern grown plants imported from Georgia and Louisiana. Caused strong sentiment among growers against the use of southern grown tomato plants. Out of 76 fields surveyed, 43 (or 56%) showed the presence of wilt, 35 fields of these contained southern grown plants, of which 29 showed wilt, or 83% of the fields containing southern grown plants showed wilt. In fields containing both home-grown and southern grown plants the wilt was usually present only in southern grown plants. (Gardner).

Control of Fusarium wilt

The following general statement concerning the increasing use of wilt-resistant tomato varieties is by F. J. Pritchard:

> "Wilt-resistant tomatoes are being used more and more commonly in wilt-infected areas. They have enabled the grower of home gardens heavily infested by wilt to produce an excellent crop of fruit when they obtained little, and in many cases no fruit, with ordinary commercial varieties. They are gradually invading the areas of commercial canners and are even used to some extent by canners that are not in wilt-infested areas because of their excellent yield and quality of fruit. As soon as the new early varieties now being developed for early trucking are distributed, growers for the early market will also be able to use them. Their more extensive use is also made possible by several seedsmen who have listed them in their catalogs."

The following reports on the use of resistant varieties have been obtained from collaborators:

Maryland: Losses are decreasing on account of use of wilt-resistant varieties. (Jehle and Temple).

Kentucky: A strain of Resistant Stone was tolerant, 75% harvested. Greater Baltimore, resistant strain was not resistant. Pink Beauty was not resistant; Essary was fairly resistant, but not the type for market. (Valleau).

Georgia: Tests conducted in Georgia during the past three years indicate that strains developed in one section of the state are not equally adaptable to all parts of the state. (McClintock[1]).

Mississippi: Large quantities of wilt-resistant seed were again distributed. (Neal).

Louisiana: Wilt-resistant selections have been giving excellent results. Probably about 5% of the tomatoes planted last year were of the resistant varieties. The percentage will be larger this year. (Edgerton).

Ohio: Results for the past season have been encouraging. (Selby).

Recent literature

Cited

1. McClintock, J. A. Tomato wilt. Georgia Agr. Exp. Sta. Bul. 138: 40. 1920.

Not cited

Edgerton, C. W. and C. C. Moreland. Tests of the wilt resistance of different tomato varieties, Louisiana Agr. Exp. Sta. Bul. 184: 1-24. Nov. 1921.

Pritchard, F. J. Development of wilt-resistant tomatoes. U. S. Dept. Agr. Bul. 1015: 1-18. Pl. I-X. Mar. 1922.

Western yellow blight attributed to Rhizoctonia spp. and Fusarium spp.

This disease was reported from Idaho, Washington, Oregon, and California as more severe even than in 1920 when more than 10% of the crop was reported lost. It seems to have been the limiting factor in tomato production in these states. Probably no disease of the crop in the west needs closer attention in order to clear up confusion as to etiology. A promising report of the marked resistance of certain varieties comes from Idaho. The following comments of collaborators show the general situation:

Idaho: Scattered in southern end of state. In kitchen gardens as well as commercial fields. Infection varies from trace to 5%. Also common in North Idaho. Marked resistance shown by some varieties and selections which are being tested by the Idaho Station. Disease more severe this year than last. (Hungerford).

Washington: This disease is appearing with its usual severity in various parts of the state. (Dana).

Oregon: Causing close to 50% loss in the region of The Dalles which is the main tomato growing area of the state. It is the one chief limiting factor to the successful production of tomatoes in that region. (McKay).

California: More severe this year than during the previous four years. Controlling factor in summer crop. About 15% is the average for the state. The range of loss extended from 2 to 100% for the fields of southern California and from 2 to 15% for central California. (Milbrath).

Table 68. Estimated percentage loss from yellow blight of tomato, 1921.

State	Percent loss	Date of greatest damage	Earliest report
Idaho	20	August	July
Washington	10	-	August
Oregon	3	August	-
California	15	July 15 - August 15	June 1

Early blight and nailhead spot caused by Macrosporium spp.

Early blight as a diseased condition considered apart from the fruit disease, nailhead spot, was reported for the most part from the northern area, where it caused serious damage in only four states. While nailhead fruit spot was reported by collaborators from Florida and Louisiana only, it was found on tomatoes shipped from California, Mississippi, and Texas, according to the reports of inspectors of the Bureau of Markets and Crop Estimates, which are summarized in Table 69. In most of the reports from the southern states where nailhead spot occurs, no differentiation was made between early blight and nailhead spot.

Table 69. Losses from nailhead spot of tomatoes as shown by examination of cars at destination by food-products inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	Number of cars with nailhead spot	Average percentage of nailhead spot	Range of percentage of nailhead spot: Number cars	Range of percentage of nailhead spot: Percent
California	1	15	1	15
Florida	38	16	1	100
			7	25-50
			24	5-20
			6	2-4
Mississippi	2	5	2	4-6
Texas	1	11	1	11
Mexico	1	6	1	6
West Indies	1	10	1	10

Number of cars with nailhead spot.......... 44
Number of cars of tomatoes inspected.......482

The relative importance of these troubles in the various states is indicated as follows:

Slight - Rhode Island, Connecticut, New York, Delaware, North Carolina, South Carolina, Ohio, Indiana, Michigan, Wisconsin, Minnesota, Iowa.

Moderate - Pennsylvania, Virginia, Maryland (2%), Mississippi (1-5%), Texas (2%).

Severe - Massachusetts, New Jersey, West Virginia (10%), Florida, Louisiana (10%), California (4%).

The following comments from collaborators give the situation for 1921. (See also Pl. Dis. Bul. 5: 54. 82-83, 117. 1921).

New Jersey: Alternaria leaf blight and fruit rot was prevalent throughout New Jersey in 1921. The fruit rot was very important on the last pickings. September 19th, one field of late crop Baltimore tomatoes was examined and at this time the Alternaria fruit rot infection was found to vary from 1 to 21%. The disease on the foliage caused much damage in some localities but was of minor importance in comparison to the disease of the fruit. (Poole).

Louisiana: The early blight of tomatoes, or nailhead spot as it is sometimes called, is a very important disease in southern Louisiana. The principal damage is from the leaf stage as many varieties are completely defoliated in the Gulf region. Next to wilt, this is our most serious tomato disease. (Edgerton, Jan. 15, 1922).

Texas: Prevalent, 2% loss. (Taubenhaus).

Indiana: Not important. Worse in southern Indiana. Serious infection noted on staked Bonny Best in market garden. (Gardner).

California: Early blight was more severe this year than for four years. The disease attacked the petioles and small stems as well as the leaves. Loss for state 4%. (Milbrath).

First appearance of early blight of tomato, 1921

May 21..................	Wood County, West Virginia
July 15.................	Delaware
September 1.............	Madison, Wisconsin
September 9.............	Calhoun, South Carolina

Mosaic (cause undetermined)

There has been some question as to the potential seriousness of tomato mosaic, but from the results of recent work it seems to be worthy of close attention. Gardner and Kendrick[1], and Melhus[2], have established the importance of the common perennial solanaceous weeds, *Physalis* spp. and *Solanum carolinense*, in carrying the disease through the winter, and, as new lands are used for tomatoes, in providing sources of infection which make the production of a crop increasingly difficult.

In 1921, the usual scattered reports of the occurrence of mosaic in greenhouses were made. In New York, Illinois, and Oregon it was a serious disease of tomatoes under glass, and in Ohio, while it occurred locally in truck sections, it caused greatest losses to the greenhouse crop. Chupp reports as much as 20% in one greenhouse and 50% in another in Ithaca; while in Oregon as much as 100% of the plants were affected in some houses, with a 50 to 75% reduction in yield, although the loss for the state was slight.

The disease was reported on field-grown tomatoes in Connecticut, Rhode Island, New Jersey, Pennsylvania, Virginia, West Virginia, Kentucky, Louisiana, Arkansas, Ohio, Indiana, Iowa, Kansas, and California. In Connecticut, according to Clinton it was lessprevalent than in 1920. In Rhode Island it was said to be common in some gardens, but not generally serious. Cook reports it as more abundant in New Jersey than formerly, and R. F. Poole makes the following statement concerning conditions in that state:

> "The mosaic and filiform disease of tomatoes is prevalent and the cause of heavy losses in all localities of New Jersey. The disease has persistently caused heavy losses of tomatoes growing in the field and also in the greenhouse. The latter crop has been very largely abandoned in some localities. Aphid infestation of tomatoes has been important on tomatoes in this state for several years. This infestation is no doubt related to the amounts of distribution, prevalence, and loss due to mosaic and filiform."

Thurston and Orton report a field in Center County, Pennsylvania, which showed 100% mosaic. F. J. Pritchard states that most fields at the Arlington Experimental Farm showed 100% of the plants affected by mosaic. The disease is said to be of slight importance in West Virginia. Valleau reports 100% infection at the Experiment Station in Kentucky, Edgerton states that the disease was very common and serious in nearly all tomato plantings in Louisiana. Elliott says that the disease was less prevalent in Arkansas. Gardner considers the disease worse in Indiana than it was in 1920 and states that it is a serious factor in the canning crop, due to early infection which reduced the yield. Mosaic was a very important trouble in Iowa, according to Melhus, and Melchers reported it as very common and causing loss of production in most fields in Kansas. D. G. Milbrath states that mosaic is on the increase in California. The symptoms extend from the fern leaf condition to mottling and rolling. Affected plants set little fruit.

Losses reported by collaborators were as follows: New York, trace to 5% (greenhouse); Arkansas, 3%: Indiana, 2%: Iowa, 11%: Oregon, slight (greenhouse); California, 1%.

The disease was first observed on the following dates:

February 24...............	Ithaca, New York (Greenhouse)
April 13..................	Riley, Kansas
May.......................	Louisiana
May.......................	Corvallis, Oregon (Greenhouse)
June 10...................	Lafayette, Indiana
August....................	Westville, Connecticut

Literature cited

1. Gardner, M. W. and James B. Kendrick. Overwintering of tomato mosaic. (Abstract) Phytopath. 12: 41-42. Jan. 1922.
2. Melhus, I. E. Mosaic studies. (Abstract) Phytopath. 12: 42. Jan. 1922.

Late blight caused by *Phytophthora infestans* (Mont.) De Bary

No report of this disease given extends the range published in last year's report. The hot, dry season was commonly reported as being responsible for lessening its prevalence. The following comments from collaborators are of interest:

Pennsylvania: Reported only from Luzerne County this year. (Thurston and Orton).

West Virginia: Much less than last year, causing slight reduction in yield. The range was local in the higher altitudes of Tucker and Upshur Counties. First seen August 15 in Upshur County. Good control obtained with Bordeaux 5-5-50. (Giddings).

North Carolina: Very destructive in mountainous sections at elevations above 3,000 feet. (Foster).

According to Colin G. Welles[1], late blight of tomato is an important disease in the Philippine Islands, at Trinidad in the Mountain Province. (See also under potato mosaic).

Literature cited

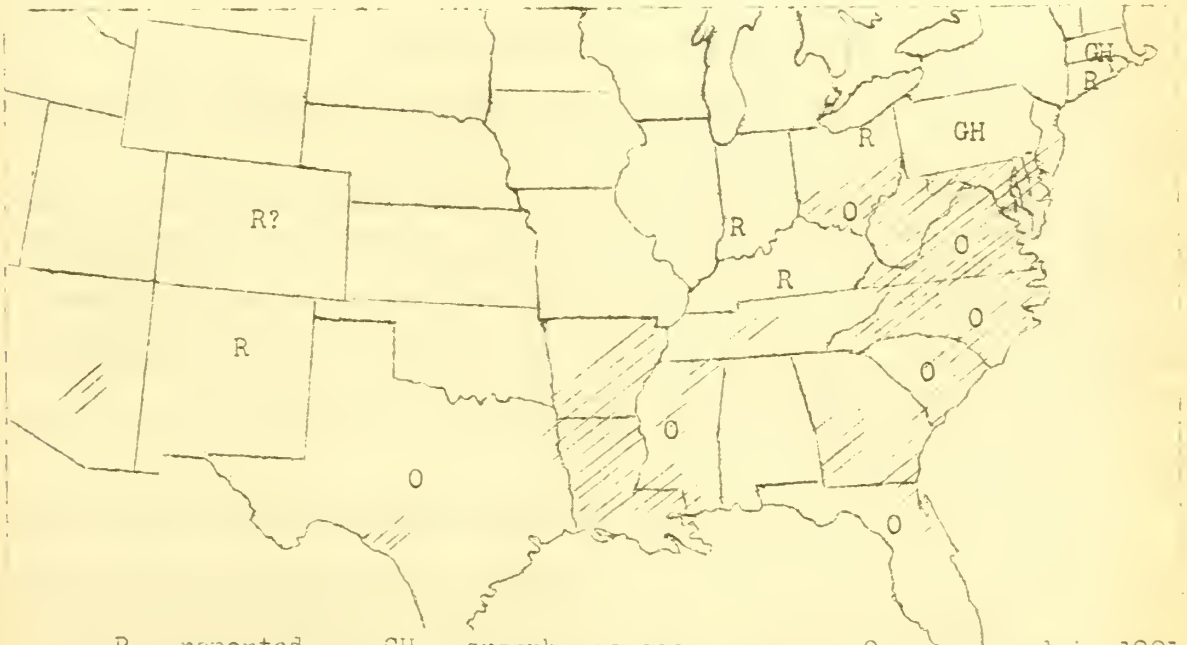
1. Welles, Colin G. Plant diseases found at Trinidad, December 1921. Philipp. Agr. 10: 348-349. Febr. 1922.

Bacterial wilt caused by Bacterium solanacearum EFS

This disease was reported as doing slight damage in a number of the southeastern Coast States. In loss of production it was pronounced less important in 1921 than in the preceding season.

E. F. Smith[1] states: "In the United States it occurs from Maryland and New Jersey south to Florida, Cuba, and Porto Rico, but its northern and western distribution in this country are unknown. It seems to thrive best in the eastern United States in washed river sands."

The accompanying map (Fig. 78) summarizes the distribution records of the Plant Disease Survey.



R - reported GH - greenhouse occurrence O - occurred in 1921

Fig. 78. Distribution of bacterial wilt of tomato as reported to the Plant Disease Survey, 1903-1921.

The damage done in 1921 was slight, with the possible exception of the North Carolina crop, as is evidenced by the following comments of collaborators:

Connecticut: One doubtful case. (Clinton).

Virginia: Occasional, severe when it does occur. (Fromme).

Kentucky: One suspected case. (Valleau).

North Carolina: Destructive in several counties. Five percent loss. (Foster).

South Carolina: Greatest loss is due to necessity of leaving tomatoes completely off infected soil. (Ludwig).
Northwestern half is heavily infested. (F. J. Pritchard).

Florida: Slight in amount, complete loss in some fields. (Burger).

Mississippi: One field observed. (Neal).

Ohio: Less frequent; present in limited extent in all greenhouses, less serious in field. (Selby).

California: Not observed; may be present. (Milbrath).

Literature cited

1. Smith, E. F. Bacterial diseases of plants. 1920 p. 182.

Blossom-end rot (non-parasitic)

The distribution of blossom-end rot in 1921 is indicated on the accompanying map (Fig. 79). It will be noted that Arizona reported it as occurring in 1921 for the first time.

In some sections high temperature and drouth made this disease severe, but in the majority of tomato growing sections the drouth was broken during the tomato ripening period and for the central-western states blossom-end rot was less than usual. The drouth effects seem most important in producing the break-down when operative at time of maximum fruit expansion, and blossom-end rot, while appearing on fruit of a certain size, may be totally absent from both younger and older sets.

The comparative prevalence of the disease and losses caused by it are shown in Tables 70 and 71.

Table 70.Comparative prevalence of blossom-end rot of tomatoes, 1921.

States reporting same or less damage for 1921 than for 1920	States reporting more loss in 1921 than in 1920
Vermont, Pennsylvania, Virginia, West Virginia, Ohio, Indiana, Illinois, Wisconsin, Minnesota, Iowa, North Dakota, Kansas, Idaho, Washington and Califonnia.	New York, South Carolina, Georgia, and Mississippi.

Table 71. Losses caused by blossom-end rot of tomato, as estimated by collaborators, 1921.

State	Percent of Crop	State	Percent of Crop
New York	3-10	Indiana	.2
South Carolina	5	Minnesota	t
Georgia	20	Iowa	1.
Mississippi	20	Kansas	1.
Texas	4	Oregon	Slight
Arkansas	3	California	6.
Ohio	1-2		

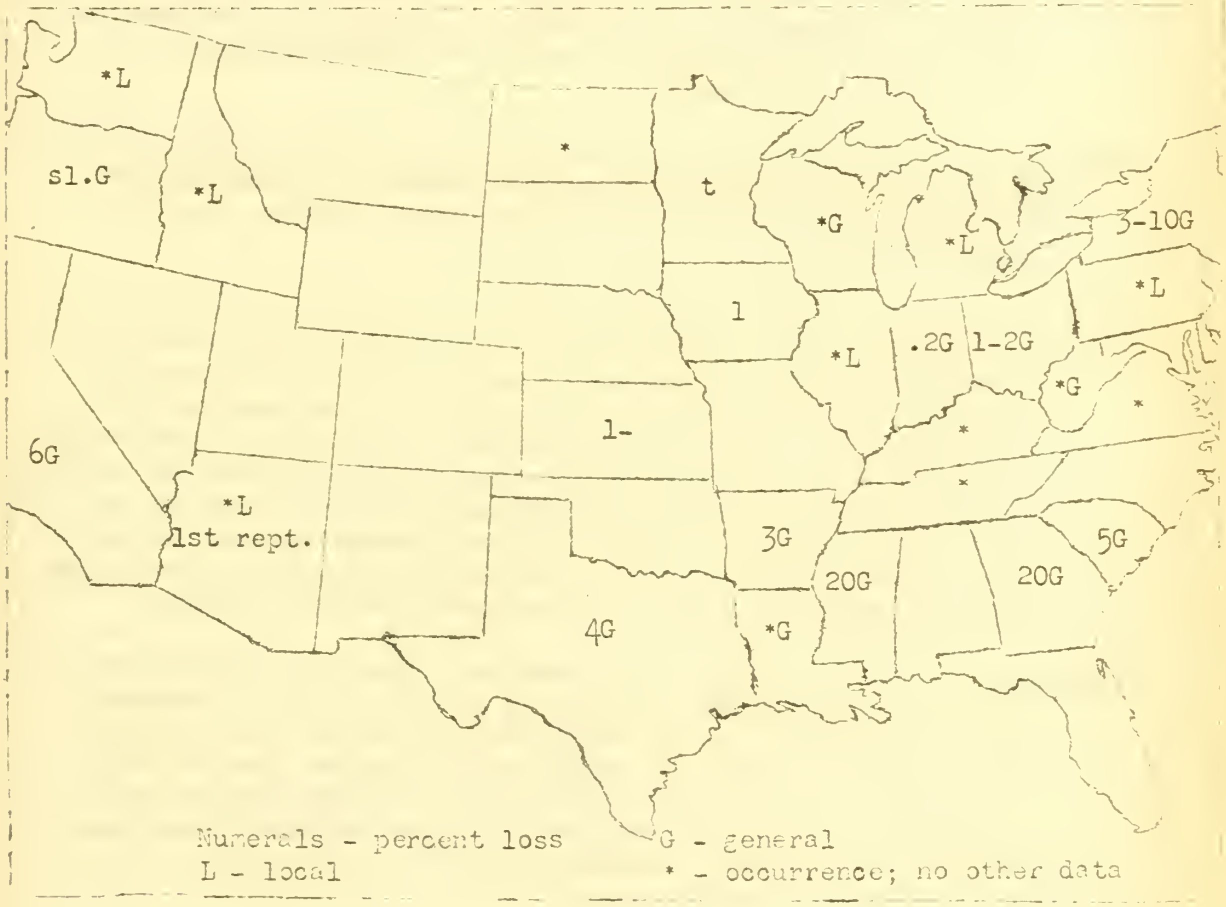


Fig. 79. Occurrence of and losses from blossom-end rot of tomato as reported to the Plant Disease Survey, 1921.

Dates of first appearance

June 23....Freewater, Oregon
July 11....Chautauqua, Kansas
July 14....Stark County, Ohio
August 25.....Madison, Wisconsin
September 15...Tucson, Arizona
September 25...Burlington, Vermont

Varietal differences

No special reports on varietal resistance were made by collaborators. In response to a questionnaire it was brought out that Bonny Best, although commonly considered resistant to blossom-end rot, did not seem especially so in many sections this year. Growers in the South are interested in a variety called "Gulf State", which is resistant to blossom-end rot and to weather cracking (catface). The following comments are illuminating:

> Virginia: It is the general opinion among the growers that Bonny Best is quite resistant and this variety is planted for canning purposes in the Roanoke section for this reason. (Fromme).
>
> Tennessee: It may be stated that Professor Essary's selection of wilt-resistant tomato from Livingston's Beauty, had been selected also for blossom-end rot resistance, and according to some information at hand is comparatively very little affected with this trouble. (Sherbakoff).
>
> Georgia: Bonny Best is not extensively grown in this state, but it was observed that the varieties like Globe were less subject to blossom-end rot than some of the larger fruited varieties. (McClintock).
>
> Ohio: We have not found the Bonny Best variety any more resistant than others, and I do not know of any variety which shows sufficient resistance to the point rot disease to be worthy of mention. The effect of the dry weather in some sections was manifest after another fashion; namely, by cracking, both radial and circular, of the skin of tomatoes, especially in the region of the stem end, and frequently observed on all parts of the fruit. This resulted in more serious losses than point rot, and interfered with marketing because so many leakers developed. This physiological disease was estimated at 4%. (Thomas).
>
> Indiana: The Indiana canning crop suffered less from blossom-end rot during the last season than in the two preceding seasons. We had heavy rains during August and September, much heavier than in normal years, and these are the months when the crop is ripening. We have not noted that the Bonny Best variety is resistant to blossom-end rot. The Horticultural Department is trying to develop a resistant strain of the Greater Baltimore canning variety. (Gardner).

Buckeye rot caused by *Phytophthora terrestris* Sherb.

Collaborators reported buckeye rot from Tennessee and Indiana. Sherbakoff states that Tennessee tomatoes suffered mostly from buckeye rot, brought about by a prolonged rainy spell at a time when most of the fruit was set. The loss for the state was placed at approximately 10%. The disease was not so important as wilt or Septoria blight. Gardner reports the disease as destructive in a garden at Lafayette, Indiana, appearing August 1 and doing greatest damage in September. Excessive rainfall favored the disease. Pritchard reports this rot as occurring in small amounts in most fields at the Arlington Experimental Farm. In one field at least 50 or 60% of the fruit was infected during a wet period.

Damping-off caused by *Pythium* spp.

Damping-off doubtless occurred here and there in the various states, but is reported only from Connecticut where it occurred April 11 at Westville. In this connection it is important to call attention to recent contributions from an English worker. W. F. Bewley[1,2] reports control by watering with a copper sulphate and ammonium carbonate compound. The original should be consulted for details. He also indicates the possibilities of introduction of the organism with the seed.

Literature cited

1. Bewley, W. F. "Damping off" and "foot rot" of tomato seedlings. Ann. Appl. Biol. 7: 156-172. Dec. 1920.
2. __________ Control of "damping off" and "foot rot" of tomatoes. Jour. Min. Agr. Gt. Brit. 28: 653-654. Oct. 1921.

Phoma rot caused by *Phoma destructiva* Plowr.

Phoma rot was reported only from South Carolina and West Virginia, occurring locally in both states. This disease, which may be minor in the state of origin, becomes very important with tomatoes in transit as is evidenced by the accompanying table (Table 72) showing market losses.

Table 72. Losses from Phoma rot caused by *Phoma destructiva*, as shown by examination of cars at destination by food-products inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay		Remarks as to seriousness of decay
			No. cars	Percent	
Arizona	1	6	1	6	
California	19	20	2	77-95	Some Rhizopus rot present
			6	15-30	Associated with other decays
			6	5-12	" " " "
			5	2-4	" " " "
Florida	116	12	1	83	Some Rhizopus rot present
			25	20-45	Associated with other decays
			64	5-18	" " " "
			26	2-4	
Illinois	1	8	1	8	Phoma and soil rots, advanced
Maryland	2	39	2	8-70	Mostly anthracnose in one car

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay		Remarks as to seriousness of decay
			No. cars	Percent	
Mississippi	25	6	10	5-15	
			15	2-4	Associated with other decays
Tennessee	3	5	3	2-8	
Texas	11	10	8	6-20	Associated with other decays
			3	2-4	
Mexico	10	7	10	2-20	
West Indies	2	23	2	11-35	
Unknown	2	3	2	1-6	

Total number of cars with Phoma rot............ 192
Total number of cars of tomatoes inspected..... 712

Bacterial spot caused by Bacterium vesicatorium Doidge (Bacterium exitiosum Gardner & Kendrick)

This disease whose causal organism was described almost simultaneously by Miss Doidge and by Gardner, is given here under the prior name. Gardner states, "Miss E. M. Doidge published a few months ahead of us. The organism is the same, hence her binomial takes precedence."

Distribution in general has been southern extending as far north as central Michigan. It is reported in 1921 as less important in Indiana than in previous years, causing .2% loss. It was found in eleven out of 76 fields in central Indiana, putting in its first appearance on July 2 in Howard County. Seed disinfection is reported as giving fair control. The disease caused considerable injury in greenhouses in Kansas according to Melchers.

Milbrath of California reports a similar spot as causing .1% loss in California.

The following references will give access to the literature on this disease:

Doidge, E. M. A tomato canker. Ann. Appl. Biol. 7: 407-430. Illus. pl. xxvi. Febr. 1921, no. 4. References: p. 429-430.
Gardner, Max W. and James B. Kendrick. Bacterial spot of tomato. Jour. Agr. Res. 21: 123-156. April 15, 1921.

Winter blight (cause unknown)

Winter blight (also called stripe or streak) was reported from New York, New Jersey, Pennsylvania, Michigan, and Ontario. In general it was confined to the greenhouse crop. No figures on loss are given by collaborators, but past records for Pennsylvania and Michigan indicate the disease may be serious. Stone and Howitt[3] state that the disease is common in tomatoes under glass in Ontario, often causing serious losses and in some instances making the production of a profitable winter crop of tomatoes impossible. They report that no pathogene seems responsible and that the disease is a result of soil conditions. "During the past five years almost uniformly satisfactory results have been obtained in the control of this disease by the addition of phosphoric acid and potassium to the soil."

A similar disease, of considerable importance in England, has been attributed by Paine and Bewley[1,2] to Bacillus lathyri Manns & Taub.

Recent literature

1. Bewley, W. F. Stripe disease of tomato. Nursery and market garden. Ind. Dev. Soc. Exp. & Research Sta. Ann. Rept. 1920: 44. 1921.
2. Paine, S. G. and W. F. Bewley. Studies in bacteriosis. IV. - "Stripe" disease of tomato. Ann. Appl. Biol. 6: 183-202. Pl. 8-9, 5 fig. 1919. (Abstr. by G. R. Bisby in Bot. Absts. 5: Entry 756. Aug. 1920.)
3. Stone, R. E. and J. E. Howitt. Experiments with winter blight or streak of tomatoes. (Abstract) Phytopath. 12: 41. Jan. 1922.

Leaf mold caused by Cladosporium fulvum Cke.

Cladosporium fulvum, which has previously been reported to the Survey from all except the mountainous western states was reported in 1921 from both field and greenhouse in its usual range. Browning of Rhode Island found the disease in some gardens, but not as conspicuous as last season. Leaf mold caused considerable defoliation in the fields at the Arlington Experimental Farm during the past two years, and at the Experiment Station in Kentucky in 1921, according to Pritchard and Valleau, respectively. Dana reported it from Walla Walla County, Washington. Michigan, Indiana, Iowa, and Ohio reported the disease on the greenhouse crop. In Ohio the disease was of considerable importance as usual in hothouses, and was invariably noticed to be serious when ventilation was inadequate, according to R. C. Thomas. Gardner reports that leaf mold is serious only in greenhouses in Indiana. Coons states that the greenhouse crop in Michigan was cut off one month early by a sudden outbreak of the disease which checked the crop early in July and caused a much greater loss than usual. The disease is not commonly held in the proper light by gardeners who usually consider it unimportant, and make no effort to control it.

Reference

Makemson, W. K. The leaf mold of tomatoes caused by Cladosporium fulvum Cke. Rep. Mich. Acad. Sci. 20: 309-348. pl. xxiii-xxxvii. 1918.

Fruit rot caused by Rhizopus sp.

Rot of tomatoes caused by Rhizopus sp. is reported from Texas (Rhizopus nigricans; traces), and from California by Milbrath as follows:

> "Rot caused by Rhizopus is a field disease. Fruit not only rots in the field but also carries infective material from the field. Loss in field about 1%."

Table 73. Losses from Rhizopus rot of tomato, as shown by inspection of cars at destination by food products inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay		Remarks
			No. cars	Percent	
Alabama	3	9	3	5-17	Advanced stage
Arizona	1	4	1	4	Mostly soil rot
California	23	13	1	77	Mostly Phoma rot
			2	25-30	Associated with other decays
			14	5-18	Other decays in some cars
			6	2-4	
Florida	193	8	1	83	Mostly Phoma rot
			6	25-45	Associated with other decays
			133	5-20	Other decays in some cars
			53	2-4	
Mississippi	39	6	21	5-22	Associated with other decays
			18	2-4	" " " "
New Jersey	1	18	1	18	Some fruit rot
Ohio	1	7	1	7	
South Carolina	1	3	1	3	
Tennessee	7	12	1	30	Rhizopus and anthracnose
			6	5-10	
Texas	78	11	3	35-50	Associated with other decays
			17	15-25	" " " "
			42	5-13	" " " "
			16	2-4	
West Virginia	1	6	1	6	Generally complete
Canada	1	2	1	2	Early stages
Mexico	30	6	20	5-20	Associated with other decays
			10	2-4	
West Indies	3	11	3	5-15	
Unknown	2	12	2	10-13	

Total number cars of tomatoes with Rhizopus rot.... 384
Total number cars of tomatoes inspected............ 712

New diseases

Two new conditions are reported by Milbrath from California as follows:

Calico spotting, cause unknown. Spotting of fruit in the form of alternation of red and white has increased rapidly during the past four years, and bids fair to become a very important problem. At least 5% of all fruit produced in the fields was spotted. If I were to form an estimate of spotting from the amount found on the markets, it would easily run to 15%.

Blossom end stain, cause unknown. This disease differs from the commonly known blossom end rot in that the affected area at the blossom end consists of numerous small blotches which later coalesce to form a green-yellow area.

The affected portion does not turn black as in the case of blossom end rot. Three percent of the crop of the state was affected.

Other diseases

Anthracnose caused by Colletotrichum phomoides (Sacc.) Chester was reported as being less prevalent than usual in New Jersey and Indiana.

Collar rot, caused by various fungi. According to Pritchard[1], stem girdling at the surface of the ground may be caused by at least three fungi, Verticillium lycopersici Pritchard & Porte, Macrosporium solani E. & M., and Rhizoctonia solani Kühn. It was reported by them as occurring in 1917, 1918, and 1919 in Maryland, New Jersey, and Delaware in seedbeds and on newly set plants. The following additional 1921 report of this type of disease extends the range:

> Indiana: Serious in one field. Blackened stem lesions at ground line, probably result of seedbed infection with Macrosporium solani E. & M. First seen July 6 at Greenfield. (Gardner).

Literature cited

1. Pritchard, F. J. and W. S. Porte. Collar rot of tomato. Jour. Agr. Res. 21: 179-184. May 1921.

Stem girdle caused by Phytophthora (species not determined). This disease, newly described by Reddick (A fourth Phytophthora disease of tomato. Phytopath. 10: 528-534. Dec. 1920.) is reported from New York as follows: "One greenhouse crop discarded entirely due to this disease." (Chupp).

Root knot caused by Heterodera radicicola (Greef) Müll. Reported from West Virginia, South Carolina, Texas, Louisiana, Ohio, Arizona, and Washington, being found in South Carolina, Texas, Louisiana, and Arizona as a field disease. South Carolina (Ludwig) reports the range as general with about the usual loss. Taubenhaus reports 1% loss to the tomato crop in Texas. Edgerton of Louisiana reports the disease as very serious in some localities.

Leaf roll (cause unknown). New York, Pennsylvania, and Kentucky report a leaf roll condition which is worthy of further investigation. Leaf roll of tomato has been known since Rolfs' earlier studies, but investigation as to its cause has not been made. A report by Güssow (Leaf curling in tomatoes. Phytopath. 11: 380-383. 1921). assigns a leaf roll condition to unbalanced conditions brought about by heavy pruning. Regarding this rolling of leaves, Pritchard of the United States Department of Agriculture writes as follows:

> "The leaf roll caused by heavy pruning or excessive watering appears to be only a physiological reaction, as the leaves remain green and seem to function normally. This appearance is very striking in some foreign varieties grown in the United States without pruning or excessive watering. It is not usually regarded as a disease.
>
> "The other leaf roll, resembling leaf roll of potatoes, is quite different, resembling somewhat Western blight, but without the yellow appearance of the foliage and the decortication of the rootlets. Moreover, these plants are very unfruitful."

Soft rot of the green fruit (bacterial) caused 50% loss in home gardens at Blacksburg, Virginia. (Fromme).

Fruit rot caused by Glomerella rufomaculans (Beck.) S. & S. was reported collected in a garden at Ithaca, New York by L. M. Massey.

Wilt caused by Sclerotium rolfsii Sacc. reported by Edgerton as serious during July and August in the river districts in Louisiana, especially the northeastern portion.

Summer blight (cause unknown) was reported by Milbrath as less important than usual in California.

Wilting, brought about by influence of walnut trees, was reported for New Jersey by Cook (Wilting caused by walnut trees. (Phytopath. 11: 346. 1921.) and for Michigan by Coons, three instances being seen with black walnut and Gulf State tomato on July 5 and 6.

Weather effects were noted by several collaborators. Many commented upon the reduction of crop brought about by the drouth. Texas and Ohio report "blossom drop" as prevalent, dry air conditions seemingly interfering with pollination.

Sunscald did some damage in Indiana chiefly in opening the way for secondary invaders.

Growth cracks and catface. Important in Indiana, causing loss from blemishing and from secondary rots which followed. Gardner estimates loss from catface at .2% of crop and from growth cracks at 6%. "Late rains lead to cracking and infection." Thomas of Ohio reports as follows: "Conditions were much the same. A very large part of the tomato crop throughout the early and mid-season was lost due to cracking which occurred in the epidermis both radial and circular, thought to be due to dry weather. These resulted in a very large number of leakers which very seriously interfered with the handling and shipping of the crop." Lutman of Vermont reports, "Skin of fruit splits in rings around stem due to slow growth in August followed by September rains. Fungus infection follows."

Hydrocyanic acid injury was described by Potter, G. F. (Hydrocyanic acid injury to tomatoes. Proc. Amer. Soc. Hort. Sci. 17: 120-126. 1921) and it was reported by Gardner from Indiana, "Crinkling and distortion of younger leaves accompanied by downward curling. Noted following fumigation for insects."

Tobacco fume injury also was reported by Gardner as causing angular, intervenous, white spots on leaves.

DISEASES OF SWEET POTATO

Stem rot caused by Fusarium batatatis Woll. and F. hyperoxysporum Woll.

Sweet potato stem rot was probably the worst disease of sweet potatoes in 1921. The report for 1920 indicated a smaller loss than occurred during the 1921 season. Dry weather and high temperatures are suspected of being factors in increasing the loss from this source. The disease was reported from New Jersey, Delaware, Maryland, Virginia, Kentucky, Tennessee, North Carolina, Florida, Mississippi, Louisiana, Texas, Arkansas, Indiana, Iowa, Missouri, Kansas, and Arizona. The following table (Table 74) lists the losses reported:

Table 74. Losses from stem rot of sweet potatoes in 1921, as estimated by collaborators.

Percent loss	State
20	New Jersey
15	Mississippi, Kansas
10	North Carolina
8	Delaware
6	Iowa
5	Maryland
2	Virginia, Arkansas
1	Indiana
Trace	Florida, Louisiana, Texas

The following statements from collaborators indicate the conditions observed in the different states:

Mississippi: More prevalent than in 1920; found in 40% of the plantings in the state, affecting 10% of the plants. First seen June 10 at Meridian; becoming common. (Neal).

Arkansas: Less prevalent than last year. Found in 75% of the fields of the state, affecting up to 25% of the plants. First seen in June. (Elliott).

Indiana: Less prevalent than last year. First seen June 22 in Boone County. (Gardner).

Kansas: Worse this year than last. The disease is on the increase; found in eastern, southern, and central Kansas. First recorded May 21 in Wyandotte County. (Stokdyk).

Difference of opinion seems to exist among collaborators as to resistance of various varieties. Cook and Poole[1] report that Big Stem varieties are more resistant than smaller stem varieties. However, conditions quite the reverse are reported from Virginia (Harter). Neal reports very few varietal differences in susceptibility noted in Nancy Hall, Porto Rican, or Triumph. Stokdyk reports fields of Yellow Jersey and Nancy Hall badly infected, while the variety Porto Rico was free. Gardner reports disease severe in Yellow Jersey but not present on White Yams.

Some promise is given of control by seed selection; Cook and Poole reporting that seed selected at digging time produced slightly better sprouts than unselected seed set on infected soil. Elliott reports that seed and slip certification has established some dependable sources of seed and given some large fields free from wilt. Neal reports that the disease is becoming very general in Mississippi in spite of quarantine and preventive measures.

Literature cited

1. Cook, Mel T. and R. F. Poole. Stem rot diseases of sweet potatoes in New Jersey. Phytopath. (Abstract) 12: 51. 1922.

Black rot caused by Sphaeronema fimbriatum (E. & H.) Sacc.

Black rot was generally prevalent again this year, losses ranging from a trace to as high as 15% of the crop, as is shown in the following table.

Table 75. Losses from and prevalence of black rot of sweet potatoes in 1921, as reported by collaborators.

State	Percent loss	Remarks
New Jersey	2	Abundant. (Cook).
Delaware	1	Stand cut by early sprout infection. (Adams).
Maryland	1	Less. (Jehle and Temple).
Virginia	5	Moderate to severe, especially on late crop at Norfolk. (Fromme).
Kentucky	-	Considerable. Treated seed produced fairly clean crop. (Valleau).
Tennessee	-	Common, not serious. (Essary, Hesler, & Sherbakoff).
North Carolina	6	Considerable; especially in storage houses. (Foster).
South Carolina	.5	Less. (Ludwig).
Georgia	-	Reported.
Florida	-	Prevalent in all parts of state. (Burger).
Mississippi	15	Nancy Hall is most susceptible. (Neal).
Louisiana	-	Quite serious. (Edgerton).
Texas	5	
Arkansas	5	Mostly storage trouble. (Elliott).
Indiana	2	Field and storage rot. (Gardner).
Illinois	-	Prevalent. (Bierbaum).
Iowa	5	
Kansas	2-3	

Seed treatment coupled with rigid selection of blemish free seed-stock seems to be of considerable promise as shown by favorable reports from Kentucky, Georgia, Mississippi, Arkansas, and Kansas. Neal from Mississippi, for example, reports that the healthy seed-stock campaign has reduced to a surprising degree the amount of infection on the plant. Strict quarantine regulations are causing plant growers both within and outside of the state to make greater efforts to produce healthy plants.

Pathologists and inspection officials in certain Southern states are proposing a uniform inspection and certification system. The following report by L. L. Harter outlines the present status of the movement:

> "With respect to the sweet potato seed inspection and certification work, I would say that I returned a few days ago from the meeting of the southern agricultural workers at Atlanta, Georgia. The question of sweet potato seed inspection and certification was rather thoroughly gone into and a committee was appointed to draw up a uniform system of inspection and certification for the sweet potato districts of the South.
>
> "The states of Arkansas, Mississippi, and Georgia have already in operation a system of seed inspection. In the states of Arkansas and Georgia it is voluntary, while in Mississippi it is complusory.

> This committee seems to be of the opinion that a minimum requirement should be uniform throughout the southern states and that the inspection should largely be voluntary. It is believed that the chief benefits derived from this system would result from the creation of a demand among the consumers for clean seed. If a uniform system of certification can be adpoted, to which all the people concerned throughout the different states will agree, it would enable the shippers to send the potatoes or plants from one state into the other, provided they carried a certificate from the proper certified officers of that state." (March 3, 1922).

Heavy rot in a storehouse with forced ventilation system was reported by Elliott in Arkansas.

Losses from black rot, associated in many instances, to be sure, with decays of other sorts, have been compiled from reports of car inspectors (Table 76). These reports show the tremendous importance of the disease as a market problem. It is very evident that loss in the field is but a small percentage of the total loss levied upon the crop from this cause. The development of general and efficient control regulations seems well warranted from this showing of the importance of this disease.

Table 76. Losses from black rot of sweet potato caused by _Sphaeronema fimbriatum_ as shown by examination of cars at destination by inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay		Remarks
			No. cars	Percent	
Alabama	1	8	1	8	Some Rhizopus rot
Arkansas	2	10	2	2-18	
Delaware	2	8	2	6-10	
Georgia	18	13	2	45-63	Associated with other decays
			7	9-25	
			9	2-4	
Indiana	1	3	1	3	Black rot and foot rot
Louisiana	3	4	3	2-6	
Maryland	5	3	5	2-5	Some Rhizopus rot in one car
Mississippi	1	77	1	77	In large spots
North Carolina	1	14	1	14	Black rot and dry rot
South Carolina	1	11	1	11	
Tennessee	2	7	2	1-13	Mostly Rhizopus in one car
Texas	1	12	1	12	
Virginia	4	20	1	70	Severe decay
			3	1-5	
Unknown	2	16	2	10-22	

Total number of cars of sweet potatoes with black rot... 44
Total number of cars of sweet potatoes inspected....... 245

Soft rot caused by _Rhizopus_ spp.

Losses from soft rot are important in New Jersey, Maryland, Florida, Texas, Arkansas, Iowa, and Kansas. Potatoes exposed for sale in markets generally suffered heavy shrinkage from this factor as is brought out by the inspection reports from the Bureau of Markets and Crop Estimates. Research by Lauritzen and Harter[1] indicate that Rhizopus tritici and Rhizopus nigricans are chiefly responsible for the decay, R. tritici working at the higher temperatures and R. nigricans at the lower, the two over-lapping between 20° and 30°C. Other species are also factors in rotting. Because of its temperature relations R. nigricans is the principle agent of decay. Elliott reports that better storage facilities have greatly reduced losses, which may be high as is evidenced by a report from Stokdyk in Kansas that there some storage houses poorly ventilated showed one-half loss due to this disease.

Recent literature

Cited

1. Lauritzen, J. I. and L. L. Harter. The species of Rhizopus responsible for the decay of sweet potatoes under storage conditions. (Abstract) Phytopath 12: 51. Jan. 1922.

Not cited

Harter, L. L., J. L. Weimer, and J. L. Lauritzen. The decay of sweet potatoes (Ipomoea batatas) produced by different species of Rhizopus. Phytopath. 11: 279-284. July 1921 (Nov.).

Weimer, J. L. and L. L. Harter. Respiration and carbohydrate changes produced in sweet potatoes by Rhizopus tritici. Jour. Agr. Res. 21: 627-635. Aug. 1, 1921.

Soil rot caused by Cystospora batata Elliott

Soil rot is said not to occur in Tennessee and Mississippi, and in Louisiana it was found for the first time this year, according to Edgerton. Collaborators reported as follows:

Delaware: First observed August 10. Heavy infection on soil planted continuously to sweet potato for ten or more years. Plants easily recognized by retarded growth and root system severely crippled. In some fields 100% of stand infected. Loss for state 2%. (Adams).

New Jersey: Infection about 75% in restricted areas. Not general. Loss sometimes 50%. (Cook).

Maryland: Five-tenths percent reduction in yield for state. (Temple and Jehle).

Virginia: Unusually prevalent throughout the state. (Fromme).

Louisiana: Occasional. First report in state. (Edgerton).

Texas: Trace. One percent reduction in yield for state. (Taubenhaus).

Kansas: Only a trace in a very few fields. (Melchers).

Scurf caused by Monilochaetes infuscans Hals.

Sweet potato scurf was present in practically the same amount as in other years, producing serious blemish rather than reduction in yield. The figures given in the following table are to be interpreted from the point of view of lowered market value rather than direct effect to the crop.

Table 77. Losses from scurf of sweet potato, as estimated by collaborators.

State	Percent loss	State	Percent loss
Maryland	.5	Kansas	2% in Arkansas Valley
Mississippi	2.	Arizona	Very important
Arkansas	t		

Seed treatment was reported by Elliott as effective in Arkansas. The report from Kansas is the first for that state, although E. A. Stokdyk believes the fungus has undoubtedly been present for some time. It was first found August 3 in Reno County. In Arizona, Brown calls attention to the relation of heavy soils to heavy infection and reports that the blemish is often followed by Rhizopus rot. The disease was first seen October 26 at Casa Grande, Arizona.

Other diseases

White rust caused by Albugo ipomoeae-panduranae (Schw.) Swingle was reported as unimportant from New Jersey, Delaware, and Arkansas, and from North Carolina by Foster as follows: "Found in one section to be very destructive and causing considerable defoliation. This is evidently the first report of this disease causing considerable damage."

Leaf spot caused by Phyllosticta batatas Cke. was reported from South Carolina as negligible.

Leaf spot caused by Cercospora batatae Zimm., a very serious Chinese disease, was found during 1921 at the College of Agriculture in the Philippine Islands, according to Colin G. Welles (Philip. Agr. 10: 253-254. Dec. 1921). A species of Cercospora which has not been determined but is possibly the same one was found by Welles in the important trucking section at Trinidad in the Mountain Province, also, but it was not severe.

Mosaic (cause unknown) was reported from Arkansas by Rosen as present to a limited extent in almost every field inspected, according to G. G. Becker, Chief Inspector, Arkansas Plant Board.

Root rot caused by Ozonium omnivorum Shear was reported only from Texas (very prevalent, loss 10%. - Taubenhaus).

L. L. Harter (Farmer's Bul. 1059, page 16) makes the following comment concerning this root rot: "Root rot, so far as known, occurs only in Texas, New Mexico, Oklahoma, and Arizona. When the disease once gets into a field, a whole crop may be destroyed. Large fields have been seen in which not more than 10% of a crop was produced..... The organism lives from one season to the next in the soil on dead vegetable matter, or in the far South probably on growing winter crops. It is killed by hard freezing, and this alone probably restricts the disease to the Southern states."

Foot rot caused by Plenodomus destruens Harter was reported from Maryland, Tennessee, North Carolina, Florida, Mississippi, and Kansas, and was definitely reported as not known to occur in South Carolina, Louisiana, and Texas. In general, it was of minor importance, producing loss in only a few localities, for example, from Tennessee 33% loss was reported by Essary, Sherbakoff, and Hesler. In other localities the loss was slight.

L. L. Harter (Farmer's Bul. 1059, page 12) makes the following statement as to occurrence and prevalence: "Foot rot is known to occur in Virginia, Iowa, and Missouri, and it is likely that it occurs elsewhere. Owing to the fact that it is not so widely distributed, the total loss that may be attributed to this disease is much less than with black rot and stem rot. In localities where it does occur, however, it produces greater loss than either of these diseases. In certain sections of Virginia, Ohio, and Iowa, it has been estimated to produce a loss of 50% of the crop in one year."

Rot due to Trichoderma koningi Oud. was reported present in Delaware.

Java black rot caused by Diplodia tubericola (E. & E.) Taub. was reported from Texas where it caused .5% damage.

Rot caused by Sclerotium rolfsii Sacc. was reported from Dallas County, Texas.

Charcoal rot caused by Sclerotium bataticola Taub. was reported from Delaware and Texas.

Root knot caused by Heterodera radicicola (Greef) Müll. was reported as fairly severe in Arkansas, being found in 15% of the plantings, affecting on an average 10% of the plants and reducing the yield of sweet potatoes for the state about 3%. (Elliott).

Internal breakdown (non-parasitic). Collaborators have occasionally reported occurrence of flesh discolorations in sweet potatoes which simulated conditions known for other crops. The following statement by L. L. Harter was made concerning specimens received from Georgia (1920 crop): "There is a breaking down of certain physiological conditions which is not well understood. The internal breakdown occurs generally at the latter end of the storage period, along about March or April. No fungus seems responsible. Certain varieties are more susceptible to this disturbance than others."

Similar trouble, known in Illinois under the name of "dry heart", was reported March 1 from Wabash County. The above reports concern themselves with the 1920 crop. Gardner reports an internal brown spot in which small patches of brown corky tissue scattered through the root occur. This was collected at Liberty, Indiana, September 20, 1921.

Drouth injury was reported from Delaware, where it cut the yield from 10 to 30% in some places during August and September. (Adams).

The following state handbooks on sweet potato diseases appeared in 1921:

Manns, T. F. The control of sweet potato diseases. Trans. Penin. Hort. Soc. 34: 77-80. 1921. Some practices that keep down diseases; control of disease and rots in sweet potato storage.

Neal, D. C. Diseases of the sweet potato in Mississippi and their control. Miss. Agr. Exp. Sta. Bul. 190. 16 p. illus. Dec. 1920.

Taubenhaus, J. J. Field diseases of the sweet potato. Sweet potato Bul. v. 2, p. 1-3, 26-27. Dec. 1921.

Cook, M. T. and R. F. Poole. Diseases of sweet potatoes. New Jersey Agr. Exp. Sta. Circ. 123. 24 p. illus. April 1921.

DISEASES OF BEAN

Bacterial blight caused by Bacterium phaseoli EFS

This disease continued in 1921 to be the most serious menace to the bean industry. As shown by the accompanying map (Fig. 80), the disease was prevalent over the entire eastern United States except Vermont and New Hampshire. C. W. Rapp[4] states that in Oklahoma, "The appearance of bacterial blight as a serious disease is dependent upon weather conditions. Warm, wet weather favors its development." The relation to temperature was well borne out in the experience of last season and in the majority of states there was enough rainfall to insure the strong development and spread of the parasite.

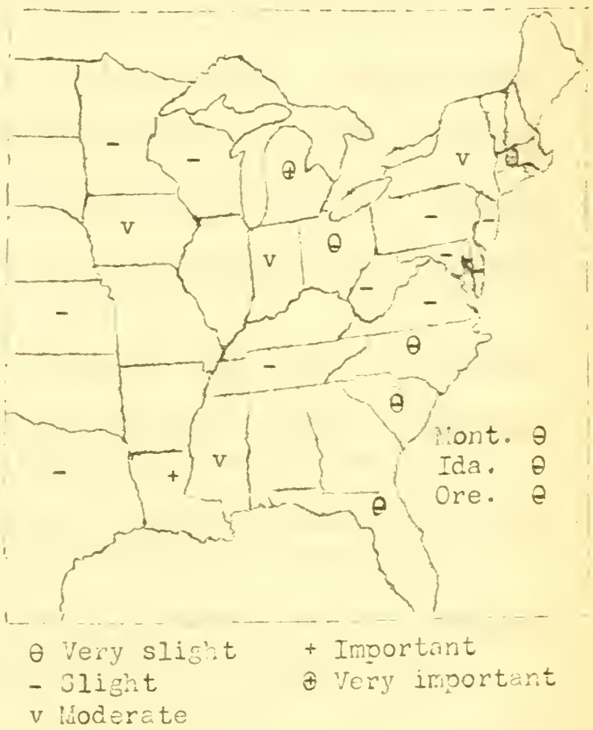


Fig. 80. Distribution and importance of bacterial blight of bean in 1921.

Table 78. Losses from bacterial blight of bean as reported by collaborators, 1921.

Percent loss	State	Percent loss	State
25	Michigan	2-3	Ohio
5-10	Louisiana	2	South Carolina
6	Pennsylvania	1	Maryland, West Virginia, Arkansas, Minnesota, Montana
5	Mississippi		
3-5	New York		
4	Indiana	.5	Georgia, Wisconsin
3	North Carolina, Iowa	t	Idaho, Oregon

Markets inspectors found the disease in shipments of beans from four states, viz., Louisiana, 3 cars with an average of 18% blight spotting; Texas, 2 cars with 9% average; Alabama, 1 car with 50%; and Florida, 1 car with 3%.

Dates of first appearance of bacterial blight of bean, 1921

April 29. Starkville, Miss.
July 1... Ramsey County, Minn.
July 1... Medford, Ore.
July..... Monroe County, Ohio
July 12...... Marion County, Ind.
August 6..... Doniphan, Kans.
August 8..... Wyoming County, N. Y.
September 20. Newark, Del.

The following comments from collaborators are of interest:

New York: Kidney types most susceptible of the field beans. (Chupp).

Delaware: On the increase. (Adams).

Virginia: General - especial complaints from Orange, Pulaski, and Montgomery Counties. (Fromme).

West Virginia: Injury mostly to leaves. (Giddings).

Tennessee: (Area near Chattanooga). Common; damage about 5%.(Sherbakoff).

Indiana: Most serious disease of beans. (Gardner).

Michigan: Cut crop short, causing heavy loss in field of high promise. (Coons).

Wisconsin: State wide. (Vaughan).

Minnesota: Found in 75% of fields affecting 75% of the plants. (Section of Plant Pathology).

Iowa: Less than last year. Found in 50% of the fields, affecting approximately half of the plants. (Melhus).

Oregon: Not very important; probably coextensive with host. Kentucky Wonder reported to be almost impossible to mature in Jackson County because of blight. (Barss).

Quebec: Beans were very severely attacked by Pseudomonas phaseoli. (B. T. Dickson[2]).

In a noteworthy contribution, Burkholder[1] shows that bean blight may be a systemic as well as a local disease and this relation must be considered in all control studies. Burkholder also confirms the observation of Muncie[3] as to nodal infection with weakened or necrotic nodes and subsequent breaking over of the vines resulting. This condition was reported in 1921 only from Michigan where considerable damage of this sort was seen, especially with beans in locations exposed to wind sweep.

Varietal resistance and selection of resistant strains is evidently the hope of the future for bean blight control. At present no very good leads exist. Coons reports scarlet and white runner beans as apparently resistant to bean blight but especially subject to hopper-burn. After a close inspection of about 60 seedsmen's varieties, grown in parallel rows, Gardner reports that blight occurred on all, but that the variety "Bird-eye" was not heavily infected. He also reports what apparently was typical blight on the following beans (see mosaic for scientific names): Mung, urd, and hyacinth; while no lesions were noted on moth, rice, adzuki, or kulthi beans similarly exposed to infection.

Rapp[4] reports the disease on Phaseolus vulgaris and on the following: runner varieties (P. multiflorus), the two limas (P, lunatus and P. lunatus macrocarpus), the pinto (a type of P. vulgaris), and occasionally on the black-eyed cowpea (Vigna sinensis).

Literature cited

1. Burkholder, Walter H. The bacterial blight of the bean; a systemic disease. Phytopath 11: 61-69. Febr. 1921.
2. Dickson, B. T. Maladies des plantes en 1920-21. Ann. Rep. Quebec Soc. Prot. Plants 13(1920-21): 66-67. 1921.
3. Muncie, J. H. A girdling of bean stems caused by *Bacterium phaseoli*. Science n. s. 46: 88-89. July 27, 1917.
4. Rapp, C. W. Bacterial blight of beans. Oklahoma Exp. Sta. Bul. 131: 3-29. 1920.

Anthracnose caused by *Colletotrichum lindemuthianum* (Sacc. & Magn.) Br. & Cav.

Anthracnose was generally less important in 1921 than it was in 1920. Reported then as causing the most serious loss for years in New York, it presents in 1921 the interesting result of still causing a considerable loss in that state in spite of weather unfavorable for its spread. This condition was due doubtless to the heavy seed infestation.

Table 79. Relative prevalence of and estimated losses from bean anthracnose, as reported by collaborators, 1921.

State	Amount compared with		Percentage
	1920	Average year	loss
New Hampshire	- -	Less	-
Vermont	Less	Less	1-3
New York	Less	Less	3-5
New Jersey	Less	Less	2
Pennsylvania	About same	About same	5
Maryland	Less	Less	1
Virginia	- -	About same	-
West Virginia	Less	Same	2
Mississippi	Less	Less	2
Louisiana	About same	About same	2-5
Texas	- -	- -	1
Arkansas	- -	- -	1
Ohio	Less	Less	5
Illinois	Same	Same	t
Wisconsin	Less	Less	t
Minnesota	Less	Less	0
North Dakota	Same	Same	-
Iowa	Less	Less	.5
Kansas	- -	- -	t
Oregon	- -	- -	t

Anthracnose spotting occurred on string beans in 10 of the 108 cars inspected by the Bureau of Markets and Crop Estimates, from the following states: South Carolina, 4 cars with an average of 3% anthracnose; Mississippi, 2 cars with 6%; Louisiana, 2 cars with 14%; and Texas, 2 cars with 2%.

Dates of first appearance of bean anthracnose, 1921

May 6.... Wiggins, Miss.
June 17.. Portsmouth, N. H.
July 1... Medford, Ore.
July ..... Rocky Ford, Colo.
August 1.. Madison, Wis.
August.... Wayne County, Ohio.

For comments of collaborators see Pl. Dis. Bul. 5: 34, 50, 68, 85, 101. 1921.

Breeding for disease resistance carried on in many experiment stations promises successful results. Investigational work reported from the Cornell Agricultural Experiment Station[1,2] and from the Michigan Agricultural College indicates progress.

Recent literature

Cited

1. McRostie, G. P. Inheritance of disease resistance in the common bean. Jour. Amer. Soc. Agron. 13: 15-32. Jan. 1921.
2. Reddick, D. A hybrid bean resistant to anthracnose and to mosaic. (Abstract) Phytopath. 12: 47. Jan. 1922.

Not cited

Barrus, M. F. Bean anthracnose. New York (Cornell) Agr. Exp. Sta. Memoir 42: 101-215. Fig. 10-20. Pl. 1-8. July 1921.

Rust caused by Uromyces appendiculatus (Pers.) Lev.

Rust, causing a spotting of the leaves and sometimes the pods, was reported from New York, Pennsylvania, Delaware, Maryland, Virginia, West Virginia, Tennessee, North Carolina, South Carolina, Florida, Mississippi, Louisiana, Ohio, Indiana, Michigan, Wisconsin, Minnesota, Colorado, Oregon, California, and the Philippine Islands[2]. The following states report definitely that the disease was not observed: Vermont, New Hampshire, Arkansas, and Iowa.

Table 80. Losses from rust of bean, as reported by collaborators, 1921.

Amount of loss	State
Slight (trace or negligible)	Massachusetts, New York, Pennsylvania, Maryland, West Virginia, Tennessee, North Carolina, Ohio, Michigan, Wisconsin, Minnesota, Colorado, and Oregon
1%	South Carolina, Mississippi
2%	California

Dates of first appearance of bean rust, 1921

May........	Jackson, Miss.
July 1.....	Medford, Jackson Co., Ore.
August 3...	Greenwood, S. C.
August 20..	East Lansing, Mich.
August.....	Wayne County, Ohio
August	Rocky Ford, Colo.
September 1..	California
September 1..	Madison, Wis.
September 6..	Onondaga Co., N.Y.
September 30.	Wyoming, Del.

Interesting notes concerning varietal susceptibility are available from several observers. In this connection the lists of Fromme and Wingard[1] should be considered. Many collaborators report the Kentucky Wonder as leading in susceptibility as will be seen from the following quotations:

New York: Mostly on pole beans or coming late on a few field beans. Onondaga County: Severe on Kentucky Wonder pole beans. (Chupp).

Delaware: On white shell beans. (Adams).

West Virginia: Pole beans affected mostly. Quite common on Kentucky Wonder. (Giddings).

Tennessee: Bean rust was common, more damaging to pole varieties. (Sherbakoff).

South Carolina: White Kentucky Wonder is susceptible to some extent. (Ludwig).

Florida: Some rust on Kentucky Wonder. (Burger).

Louisiana: In general the bush beans (snaps) are resistant. The one with which we have the most difficulty is the Kentucky Wonder. This variety is frequently killed by the rust. (Edgerton).

Indiana: The following report of the results of experiments conducted by E. B. Mains at Purdue University was received through Gardner:

The varietal susceptibility of beans in the rust experimental plot at Lafayette in 1921 was as follows:

Not affected. Pencil Pod Wax, Hodson Wax, Wardwell's Kidney Wax, Red Kidney, Saddle Back Wax, Rust Proof Golden Wax, Mohawk, Golden Eye Wax, Stringless Refugee, Valentine Wax, Black Valentine, Dwarf Horticultural, Bird's Eye, Mexican Red, Currie Rust Proof Black Wax, Improved Goddard, Yellow Eye, Masterpiece Dwarf, New Pearl, Webber Wax, California Rust Proof, Detroit Wax, Hodson Green Pod, May Queen, Trucker's Reward, Refugee (1000-1) Horticultural Pole, Wren Egg, Marblehead Pole, Home Sweet Home.

The following beans belonging to other species (see mosaic for scientific names) were not infected: Hyacinth, adzuki, urd, kulthi, rice, mung, and moth.

Slightly infected: Michigan White Wax, Full Measure, Bountiful Stringless, Early Red Valentine, Currie Golden Wax, Keeney's Stringless Refugee, Green Seeded Flagolet, Improved Golden Wax, Dwarf Horticultural, White Kidney, French Horticultural.

More or less heavily rusted: Black Turtle Soup, Robust Pea, New McCaslan, Pinto, Lady Washington, Boston Navy, Snowflake, White Creaseback, Burger Green Pod, McCaslan Pole, Golden Cluster, White Dutch Caseknife, Powell's Prolific, White Kentucky Wonder, Tennessee Green Pod, Kentucky Wonder Wax, Kentucky Wonder.

California: Among varieties found affected were Black Eye, Lady Washington, French White, Red Valentine, and Pink. (Milbrath, July 1).

Black Eye, Pink, Yellow Eye, Valentine particularly susceptible. (Milbrath, final report).

Philippine Islands (Trinidad, Mountain Province, December): This rust is very serious at the present time and according to Mr. Wright (Supt. of the Trinidad Farm School) becomes widespread, attacking all varieties with one exception...... a red variety of P. vulgaris. (Colin G. Welles[2]).

Literature cited

1. Frome, F. D. and S. A. Wingard. Varietal susceptibility of beans to rust. Jour. Agr. Res, 21: 385-404. June 15, 1921.
2. Welles, Colin G. Plant diseases found at Trinidad, December 1921. Philipp. Agr. 10: 348-349. Febr. 1922.

Mosaic (cause unknown)

Mosaic was reported from the extreme eastern and western parts of the United States and from Quebec[1] to Louisiana. Being seed-borne it may be expected to have a range practically coextensive with the crop, although as evidenced by reports from some collaborators it was not seen or was masked by weather effects last season in some regions.

The importance of the disease in 1921 is indicated in Table 81.

Table 81. Estimated losses from bean mosaic, 1921.

Amount of loss	States reporting
Not observed	Vermont, New Hampshire, West Virginia, South Carolina, Texas, Ohio
Slight	Massachusetts, Connecticut, North Carolina, Washington
Considerable	Mississippi
Severe	California
t	Michigan, Wisconsin, Kansas
1%	Louisiana, Minnesota, Montana
2%	Georgia, Arkansas, Indiana, Iowa
2-3%	Pennsylvania
2-5%	New York
5%	Oregon
10%	Idaho

Collaborators comment as follows (see also Pl. Dis. Bul. 5: 34, 50, 68, 86, 102, 1921).

Connecticut: One report; July 7 At Whitneyville, where the disease was found on Hodson Wax (50%) and on Old Homestead (10%).(Clinton).

New York: Probably same as last year; less important than several seasons ago. There has been a continued reduction in acreage of susceptible varieties. (Chupp).

Since most of the pea beans grown are the Michigan Robust, the mosaic was not a serious factor on the dry shelled beans. (Burkholder, Jan. 24, 1922).

Mississippi: Unimportant; occurring locally. First seen May 5 at Poplarville and Utica; caused greatest damage to plants two-thirds mature between April 25 and May 15. (Neal).

Louisiana: About same as usual and as last year; very common. (Edgerton).

Indiana: Noted in many gardens. About 10% of plants affected. (Gardner).

Michigan: Occasional. Evidence of field spread by insects secured by Nelson. (Coons).

Minnesota: First reported on University Farm, June 10. Infection light. Later complicated by the effects of hot weather and hopper burn. The usual symptoms of mosaic were difficult to determine in various fields about University Farm. (September 15).
General, of considerable importance; found in 90% of the fields, which showed an average of 5% affected plants. (Section of Plant Pathology).

Montana: Comparatively few beans grown on commercial scale this year. A small amount of mosaic was seen. (Jennison).

Idaho: Less than last year, but still very important. (Hungerford).

Oregon: Same as usual, serious. Coextensive with host and severe in many cases. (Barss).

California: Same as last year, severe in some localities - at Puente in Los Angeles County, and in the San Joaquin Valley. (Milbrath .

Robust bean continues in favor in many localities and large acreages for seed purposes are being grown in Michigan, New York, and Canada. Close inspection of improved strains at Michigan showed resistance to mosaic to be extremely high, whole increase plats failing to show more than an occasional individual with mosaic. Common stock, on the contrary, showed considerable mosaic. (Coons). Promising results from the point of view of both mosaic and anthracnose resistance are to be expected from the hybrids between the Robust bean and the various anthracnose resistant kinds which have been developed at several stations, and are being carefully tested to determine their commercial value.

A report from Gardner (Indiana) on observations of 60 seedsmen's varieties of beans grown in plats with short rows, shows that mosaic occurred on 37 varieties. The following varieties were free from mosaic: Wardwell's Kidney Wax, Red Kidney, Saddleback Wax, Dwarf Horticultural, Robust Pea, Black Valentine, Improved Goddard, and Webber Wax.

Of species other than P. vulgaris, Gardner reports that mosaic occurred upon: adzuki bean (Phaseolus angularis (Willd.) W. F. Wight; urd bean (P. mungo L.); mung bean (P. aureus Roxb.): but not upon: kulthi bean (Dolichos biflorus L.); rice bean (P. calcaratus Roxb.); moth bean (P. aconitifolius Jacq.); and hyacinth bean (Dolichos lablab L.); although all were similarly exposed to infection. Mosaic occurred also on lima bean (bush variety).

Recent literature

Cited

1. Dickson, B. T. Maladies des plantes en 1920-21. Ann. Rept. Quebec Soc. Prot. Plants 13: 66-67. (1921).

Not cited

Barss, H. P. Bean blight and bean mosaic. Oregon Agr. Exp. Sta. Crop Pest and Hort. Rept. 3: 192-196. Fig. 56-59. 1921. (Abstr. by E. J. Kraus in Bot. Absts. 9: Entry 918. September 1921).

Root rot caused by Fusarium spp.

Root rot definitely attributed to Fusarium spp, was reported from Massachusetts, New York, West Virginia, Tennessee, Indiana, and California. Doubtless many of the reports from other states under the general name of stem end and root rots are also assignable to this cause. Losses in general were slight, probably not amounting in any case to more than 2%. The following comments from collaborators give the facts at hand (see also Pl. Dis. Bul. 5: 35, 86, 102. 1921).

General: As to the extent of the Fusarium root rot of the beans, I have only received it from two other states besides New York; that is, Michigan and Vermont. This last summer, however, I received specimens of beans having a root rot from Indiana and Washington, D. C. In both cases it appeared to be Fusarium root rot, but as I did not make any isolations, I would not like to make a definite statement. (Burkholder, Jan. 24, 1922).

Massachusetts: Stem rot caused by Fusarium and Rhizoctonia very severe in a few instances. (Osmun).

New York: Fusarium martii phaseoli fairly general, causing a loss to the state of 1-2%; especially in the dry bean sections and in the gardens in other sections. First found July 7 at Warsaw. General distribution for the state is western. (Chupp).

West Virginia: Local. A few cases severe. (Giddings).

Tennessee: Root rot (Probably Fusarium) in some fields not uncommon. Damage to that section of the state (Chattanooga) probably about 2%. (Sherbakoff).

Indiana: Less prevalent than last year and of minor importance. Found by R. C. Friesner very severe on Kentucky Wonder and not occurring at all on Bountiful Bush, Early Leviathian Lima, and German Black Wax. First seen July 14 in Marion County. (Gardner).

California: Stem rot caused by Fusarium and Rhizoctonia worse than last year. Destroyed 75% of crop in some fields; caused an average reduction of 5% of the crop of dry beans. Limas and Red Mexican suffered most. (Milbrath).

Rhizoctonia rot caused by Corticium vagum Berk. and Curtis

Rhizoctonia, common as a soil parasite, is doubtless strongly affected by particular spring conditions. In the reports for 1920, root and stem rots of bean due to this fungus were reported as very common in New Jersey and various other states, but in 1921 this disease was of very minor importance in the United States as a whole. It was reported by Thurston as severe in Lebanon County, Pennsylvania. It was found in North Carolina; and was as usual serious on the fall crop in Louisiana. The disease occurred also in Texas, Idaho, and Washington, according to collaborators, and in Massachusetts and California, where it was associated with Fusarium sp. (See Fusarium).

Stem rot and watery soft rot caused by Sclerotinia libertiana Fckl.

This disease was reported in 1921 as less important than last year and doing only slight damage in the field. It occurred locally in New York and West Virginia. On the other hand this organism is of prime importance in causing a rot of the snap beans in transit as is shown by an examination of markets inspectors reports.

Stem rot (cause undetermined)

An unnamed stem rot caused considerable damage in a field at St. Albans, Vermont. Ludwig reports mung beans (Phaseolus aureus) severely affected with an undetermined stem rot in Chester County, South Carolina. In the Far West Barss reports that stem rot was not serious except perhaps locally in the hotter sections of eastern and southern Oregon.

In this disease complex careful work, backed by intensive study of specimens and of soil infestation, and by free interchange of material between workers seems very desirable.

Other diseases

The organism causing a new bacterial wilt of bean has been described by Miss Florence Hedges of the Laboratory of Plant Pathology, Bureau of Plant Industry, as Bacterium flaccumfaciens (A bacterial wilt of the bean caused by Bacterium flaccumfaciens nov. sp. Science n. s. 55: 433-434. April 21, 1922). The disease appeared on navy beans in South Dakota in 1920 and 1921. Miss Hedges has infected King of the Mountain and Great Northern beans, King of the Garden lima, and Ito San soy-beans by pure culture inoculations. The following quotation is from her article:

> "A new bacterial disease of navy beans has appeared in South Dakota. The grower on whose farm the disease was discovered reports that what he believes to be the same disease killed 90% of his 1920 crop. In 1921 he planted the seed harvested from the remainder and lost about 25% of his crop. Some of this 1920 Dakota seed planted at Arlington, Virginia, also produced a large proportion of diseased plants, many of which never survived the seedling stage. The disease is characterized by a wilting of the leaves of seedlings, sometimes accompanied by a discoloration, and by dwarfing, reduction of yield and the death of some of the shoots, if the plant survives the early stages of growth."

Angular leaf spot due to Isariopsis griseola Sacc. was reported from West Virginia and for the first time to the Survey from Pennsylvania and

Delaware. In West Virginia it was more important than last year, being severe in a few instances according to Giddings. Thurston and Orton report it as present in gardens in Center County, Pennsylvania. Adams reported it as first noticed on September 20 at Newark, Delaware on kidney beans. Browning reports the disease as occurring in Rhode Island in 1920, when it was very abundant and destructive to the foliage and pods, although previously it had been of only minor importance.

Leaf spot caused by Cercospora canescens Ell. & Mart. was reported by Taubenhaus as unimportant in Texas.

Powdery mildew caused by Erysiphe polygoni DC. was reported as unimportant in Texas, and as serious in California where it caused 6% loss in San Diego, Riverside, Los Angeles, and Orange Counties, according to Milbrath.

A leaf blight of husk beans, apparently caused by Rhizoctonia, was found by Sherbakoff in the vicinity of Chattanooga, Tennessee, August 11.

Rhizopus rot caused by Rhizopus sp.,typically a disease of beans under transit conditions, may cause serious loss.

A seed spot of unknown cause affecting both the surface and interior of the bean is reported by Milbrath as severe throughout southern California, causing a reduction of 30% in the yield of the variety Black Eye, to which it was confined.

Texas root rot caused by Ozonium omnivorum Shear was reported, as usual from Texas.

Root knot (Heterodera radicicola)Greef. Müll.) was reported by Ludwig as present in the northwestern part of South Carolina, and from Texas as unimportant. On the other hand, Elliott (July 1) reports that several severe outbreaks in Arkansas were brought to his attention.

Sunscald was reported from Wisconsin and Michigan as causing some defoliation.

Chlorosis, said to be caused by land too rich in lime, was reported by Taubenhaus from Texas.

DISEASES OF LIMA BEAN

Downy mildew caused by Phytophthora phaseoli Thax.

In 1920 downy mildew was reported as widespread and more destructive than usual in the northeast, occurring in seven states. In 1921, on the other hand, it was reported only from Connecticut, New York, and Delaware. The crop was injured to considerable extent in some places in Connecticut, according to Clinton. The disease was less prevalent than usual in Delaware, doubtless due to its late appearance (earliest record September 1, at Newark - Adams). It was especially severe in Suffolk County, New York as shown by the following report:

> New York: Lima beans grown to any extent only on Long Island. Mildew reported only from Suffolk County; reduction in yield 5%. Mr. I. H. Vogel states, "In Suffolk County in the fore part of the season the loss was rather heavy (15-20%). Weather conditions checked it later." (Chupp).

Bacterial blights caused by Bacterium spp.

Bacterial blights of lima bean were reported from Pennsylvania, West Virginia, and Indiana during 1921.

> Pennsylvania: Dr. Beach has reported from Bustleton a bacterial blight of pole lima beans that is causing a 5-10% loss. The disease causes a premature ripening and drying of the pods. He has observed it for four seasons but states that it has caused real loss for the first time this year. It appears to be general in the vicinity of Bustleton. (Thurston, August 15).

> West Virginia: Specimen collected at Hinton, August 5 by R. J. Haskell. Determined in the Pathological Laboratory of the Federal Department of Agriculture as being Bacterium phaseoli.

> Indiana: Bacterial blight (Bacterium phaseoli ? - may be more than one species involved) serious seed stain in canning crop. Causes spotting of leaves, pods, and seeds. First observed July 12 on pole beans in Marion County. Yellow organism isolated from pole varieties in gardens but not from canning crop disease. Our 1920 report of Phyllosticta phaseolina more than likely incorrect and should be one of these bacterial spots. (Gardner).

Other diseases

Leaf spot and pod blight caused by Diaporthe phaseolorum (C. & E.) Sacc. was reported from New York (rather severe in Suffolk County, 5-10% loss; dry midsummer), New Jersey (less severe; dry weather), and West Virginia (local; one rather severe case observed). The leaf spot reported from Indiana in 1920 under Diaporthe phaseolorum (Pl. Dis. Bul. Suppl. 16: 234-235. June 1, 1921 - reported by Gardner as Phyllosticta phaseolina Sacc.) was probably a bacterial spot instead, according to Gardner (see report quoted under bacterial blights).

Powdery mildew (only conidial stage present) - noted only in greenhouse in Indiana; reddish brown blotches under the mycelium. (Gardner).

Mosaic (cause undetermined) was reported on lima beans in Indiana (bush variety), and Missouri.

Stem rot caused by Fusarium sp. and Rhizoctonia sp. was severe on lima beans in California according to Milbrath (see quotation under Fusarium stem rot, common bean).

Lightning injury traceable to lightning striking the ground June 11 was reported by Clinton from Northford, Connecticut on June 18.

A parasitic yeast (Nematospora sp.) which causes a seed spot of lima beans resembling bacterial spot was reported by Wingard from eastern Virginia. (Wingard, S. A. A yeast parasitic on lima beans. (Abstract) Phytopath. 12: 47. Jan. 1922.

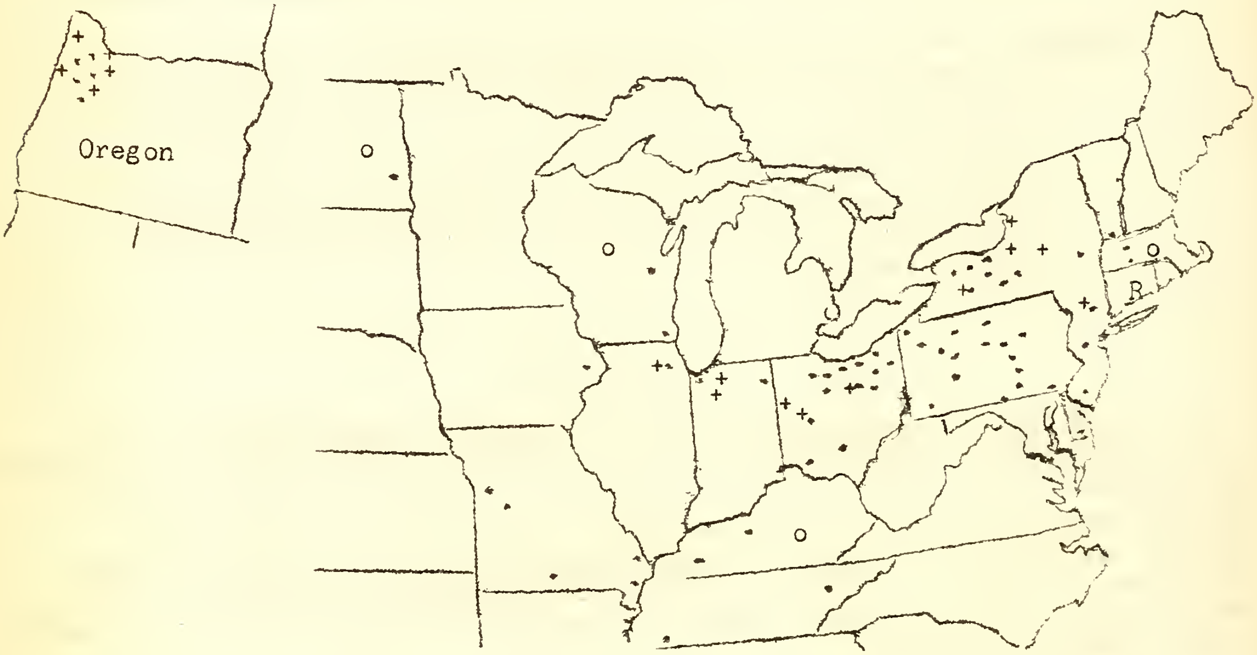
Seed stain, caused probably by Fusarium sp. was reported from Indiana: "Of considerable importance in the canning crop in Johnson County; causes brown discoloration of seed coat which renders beans worthless for canning. First reported September 10 at Greenwood. Occurs in older pods that have turned brown; probably in those in contact with soil." (Gardner).

Moldy pods, cause unknown, - reported from Kentucky: "Pole lima beans making rapid growth affected during moist weather".(Valleau).

DISEASES OF ONION

Smut caused by *Urocystis cepulae* Frost

The distribution of onion smut as it has been reported to the Survey is indicated on the accompanying map (Fig. 81). The following states definitely report the disease as never having been reported: Louisiana, Texas, Colorado, Michigan, and Minnesota.



. Reports prior to 1921 (counties)
R Reports prior to 1921, localities not given
+ 1921 reports (counties)
o 1921 reports, localities not given

Fig. 81. Distribution of onion smut, as reported to the Plant Disease Survey, 1903-1921.

Dates of first appearance of onion smut, 1921

April...............	Beaverton, Oregon
May 23..............	Orange County, New York
June 16.............	Jasper County, Indiana

In areas where extensive infestation occurs onion smut was evidently far more serious in 1921 than in previous years. Data concerning losses due to smut and prevalence of the disease are summarized in Table 82.

Table 82. Relative prevalence of and estimated losses from onion smut in 1921, as reported by collaborators.

State	Importance	Prevalence compared with 1920	Prevalence compared with Average year	Percent loss
Massachusetts	--	--	Same	--
New York	Very	More	--	20
Kentucky	Very (in sets)	Worse	Worse	15
Ohio	Moderate	Same	Same	--
Indiana	Only in sets	--	--	--
Illinois	Not very	Same	Same	--
Wisconsin	High in infected soil	More	More	--
North Dakota	Not very	Same	Less	--
Oregon	Worst disease	Worse	Worse	1

A number of states report excellent results from formaldehyde drip treatment:

Massachusetts: About the usual amount. The general use of formaldehyde gives good control on most fields. (Osmun).

New York: In Orange County preliminary counts showed 15-20% in fields not treated and 5% in treated fields. A later report showed 52% in checks. In Madison County treated rows had double the yield as compared with the check. (Chupp).

Ohio: Excellent control wherever formaldehyde drench treatment is used. (Thomas).

Indiana: C. T. Gregory reports good control in Lake County with formalin drip on seed drill. (Gardner).

Illinois and Wisconsin: Formaldehyde drip control was used more generally than ever before in the Racine, Wisconsin and Cook County, Illinois districts this season with success. (Walker).

Wisconsin: It was so cold and wet immediately after onions were planted that seed did not germinate for some time and the value of treatment was largely lost. (Vaughan).

Oregon: The two important problems in the onion growing section of Washington County are the smut and mildew. Professor Barss has a small but very convincing demonstration of formaldehyde drip control for smut in one field. He has tried out several formulae and the results coincide with those we have secured in eastern sections. (Walker, News Notes, Office of Cotton, Truck, and Forage Crop Disease Investigations, August 6, 1921, page 4).

Formaldehyde drip treatment in seeding controls very successfully. (Barss).

The following new literature has appeared, the contribution by Walker and Jones being especially pertinent in giving an explanation of the range of this disease.

Walker, J. C. and Jones L. R. Relation of soil temperature and other factors to onion smut infection. Jour. Agr. Res. 22: 235-261. Pl. 25-27. Oct. 20, 1921.

Whitehead, T. On the life history and morphology of Urocystis cepulae. Trans. Brit. Mycol. Soc. 7: 65-71. Pl. ii. July 1921.

Whitehead, T. Experiments on the control of onion smut. Jour. Min. Agr. Gt. Brit. 28: 443-450. August 1921.

Downy mildew caused by Peronospora schleideni Ung.

Downy mildew is known from the records of the Survey to occur from coast to coast. In 1920 the disease was reported from eastern, southern, and western United States. The records for 1921 parallel those of the former year. The following observations were made by collaborators (See also Pl. Dis. Bul. 5: 118. Oct. 1, 1921):

Louisiana: Very common this season on onions and shallots; doing considerable damage. (Edgerton).

Ohio: Less damage than last year, of moderate importance. First appearance late in June. (Thomas).

Oregon: Unimportant; loss a trace. General in northern Willamette Valley onion sections; also found in Coos County, July 14. Cool, moist, prolonged spring. Disease started rather actively in the spring but disappeared due to hot dry summer weather continued through harvest. (Barss).

California: About as prevalent as last year, causing 2% reduction in yield for the state. Found on seed stock in Santa Clara County. (Milbrath).

The following states report absence of downy mildew: New Jersey, Massachusetts, Texas, Wisconsin, Michigan, Minnesota, Colorado, and Washington.

Recent literature

Murphy, P. A. The presence of perennial mycelium in Peronospora schleideni Unger. Nature 108: 304. Nov. 3, 1921. No. 2714.

Various troubles caused by Botrytis spp.

Onion rots attributable to Botrytis spp. taking various forms, "neck rot", "bulb rot", "failure of sets", "blasting of seed heads", have been reported to the Plant Disease Survey and in the literature from many localities in previous years. There is evidently a complex of disease conditions, the etiology of which is not at all clear at present. In New York and Michigan the results of studies by Munn have shown definitely that Botrytis allii Munn is capable of producing all of the troubles mentioned above. With onions in transit other species of Botrytis, presumably of the cinerea type, seem to be another factor in loss production. From the data at hand, it is not possible to state the pathogene concerned. The following statements are quoted to show the importance of diseases of this type with a view to focusing attention upon this field for study.

> Indiana: Neck rot caused by Botrytis sp., doing considerable damage in Fulton County, also occurred in Kosciusko and Steuben Counties. The rot was not necessarily at the neck, but may be anywhere on the bulb. First seen with 1920 crop, March 9; with 1921 crop, August 18. (Gardner).
>
> Wisconsin, Illinois, and Kentucky: Very little neck rot noted in the Racine, Chicago, and Louisville sections. (J. C. Walker).
>
> Wisconsin: Neck rot caused by Botrytis allii less, of minor importance; too hot. (Vaughan).
>
> Idaho: Neck rot caused by Botrytis sp., unimportant. Reported from one or two isolated portions of the state. (J. M. Raeder).
>
> Washington: Neck rot, Botrytis allii, in Walla Walla and Whitman Counties. (Dana).
>
> Oregon: Bulb rot - Botrytis sp. Little known (only one record, Ashwood, Jefferson County, March 1) about the range or extent of severity. (Barss).

Reports by market inspectors separate losses into two types; neck rot and gray mold rot, but as inspection of tables show, these conditions vary and other molds are also concerned in the decay.

Table 83. Losses from gray mold rot of onions caused by Botrytis sp. as shown by examination of cars at destination by inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	
			Number of cars	Percent
California	12	8	9	5-25
			3	2
Indiana	1	6	1	6*
Iowa	4	3	4	2-6
Texas	17	6	3	15-25
			14	2-7
Washington	1	13	1	13
Spain	1	20	1	20
Unknown	8	6	8	2-12

Total number of cars with gray mold rot........... 44
Total number of cars of onions inspected..........837

---

*Associated with slimy soft rot.

Table 84. Losses from neck rot of onions caused by Botrytis sp. as shown by examination of cars at destination by inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	
			Number of cars	Percent
California	1	8	1	8*
Illinois	1	5	1	5**
Indiana	5	3	5	2-6
Kentucky	2	6	2	2-10*
Massachusetts	3	8	3	3-14*
Michigan	3	13	1	33 F
			2	2-5*
New York	22	11	11	10-33*
			11	2-9*
Ohio	5	3	5	2-8*
Oregon	8	4	8	2-8
Texas	4	32	3	27-65#
			1	3
Washington	2	10	2	8-12
Wisconsin	1	4	1	4*
Spain	6	15	4	17-25#
			2	5-6
Unknown	3	28	1	55*
			2	13-15

Total number of cars with neck rot............. 66
Total number of cars of onions inspected....... 887

*Associated with slimy soft rot ** Advanced decay
#Associated with other decays F Following freezing injury

Pink root caused by Fusarium malli Taub.

Onion pink root, known in the records of the Plant Disease Survey to occur in New York, Indiana, California, Texas, and Louisiana, was reported in 1921 from Texas, Oregon, and California. In Texas the loss was estimated at 5%. In Oregon, although it is not uncommon in the northern Willamette Valley, it is not serious anywhere, and caused only a slight loss, according to Barss. The most serious loss was reported from California by Milbrath. The total yield of the state was reduced 14% due to root decay of small onions in the Delta region where a thousand acres were almost a total loss. The disease occurred in the Coachella Valley region also.

Other diseases

Macrosporium parasiticum Thüm. was reported from Wisconsin and Louisiana (black molds, rotting of seed stalks). Studies at the University of Wisconsin by N. G. Teodoro (Pathogenicity of Macrosporium parasiticum. (Abstract) Phytopath. 12: 50. Jan. 1922) indicate that this organism, formerly considered a secondary parasite invading downy mildew lesions, may produce distinct lesions on leaf and seed stems, often girdling the latter. Comparative studies are in progress with other Macrosporia from onion. Edgerton had previously called attention to the probability of this condition in Louisiana Station Bulletin 182: page 10.

Walker reports Macrosporium rot in two lots of white onion sets found at Louisville, Kentucky, January 1922. Black mold caused by *Macrosporium* sp. was reported from Kansas.

Smudge caused by *Colletotrichum circinans* (Berk.) Voglino was reported as of minor importance from Indiana where it occurred on bulbs in storage and from Wisconsin on both seedlings and bulbs. In the latter state it was not found on the red onion which is largely grown for commerce. For a discussion of the resistance of different types see: Walker, J. C. Onion smudge. Jour. Agr. Res. 20: 685-722. Febr. 1, 1921.

Soft rot caused by bacteria of the *Bacillus carotovorus* group was reported from South Carolina, Ohio, and Indiana, occurring occasionally and doing some damage as a storage rot. In Kentucky the loss was considered very important in shipments from Louisville.

Bulb rot caused by *Fusarium* sp. was reported from Indiana (Bureau of Markets certificate; Steuben County 1921 crop; August 18 - Gardner); and a Fusarium rot was reported from Payette, Idaho by J. M. Raeder.

Black mold caused by *Aspergillus niger* Van Tieghem (*Sterigmatocystis*) was reported as unimportant from Texas (Webb County) and Indiana (Fulton County), but found to be doing considerable damage in California as a storage rot, where its reduction in yield was placed at 4% of the state yield. (Milbrath).

This mold is important in causing blemish and decay of onions in transit and storage.

Blue mold rot, *Penicillium* sp., while in general of minor importance in field and storage as compared with molds of the Botrytis type, was of considerable importance under transportation conditions, especially in long distance shipments.

Tip-burn was reported from Massachusetts. "The onion crop in Massachusetts is only about 30% of normal. The reduced yield is due largely to drouth conditions which favored tip-burn and prevented full development of the bulbs." (Osmun, September 15).

DISEASES OF CRUCIFERS

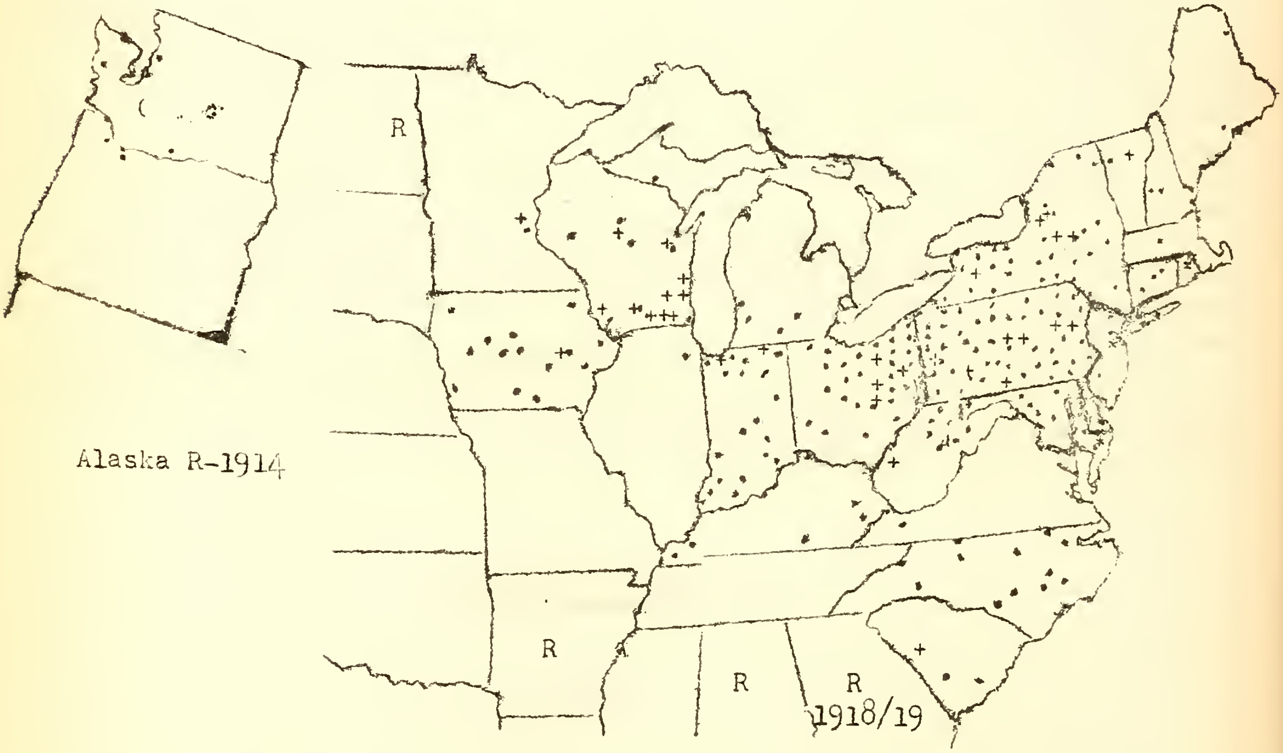
CABBAGE

Club root caused by *Plasmodiophora brassicae* Wor.

This disease is distributed throughout the United States with the exception of the western plain and mountain regions, and in 1921 was reported as doing about the same amount of damage as before. Its occurrence is occasional and serious loss occurs only locally, hence, in general, its effect on the yield is negligible. The maximum amount found in any field in Vermont was 10%, with a state reduction in yield estimated by Lutman at 1-3%.

Browning reports cauliflower to be more seriously affected than cabbage in Rhode Island. Chupp estimates that the reduction in yield for New York is between 1 and 3%. Cook of New Jersey states that the disease was severe in some cases, the loss being 1.5%. Giddings in West Virginia estimates the loss as a trace. Barre of South Carolina reports only a single case; and reports from Louisiana, Texas, and Arkansas indicate that the disease is not present in those areas. Gardner reports the disease as unimportant and known only in Lake and Elkhart Counties, Indiana. Vaughan reports the disease of minor importance in Wisconsin. In Minnesota the disease is reported as about the same prevalence as before, but not general enough to be serious, affecting 5% of the fields in the state, and estimating the loss as a trace. Melhus reports the disease as serious at Amana, Iowa. Bolley of North Dakota reports it for 1920 but not for 1921. South Dakota, Kansas, Montana, Colorado, and Washington have negative reports.

No new American investigations are reported on this disease, but work which would give more definite suggestions as to quantity of lime to be recommended on different soil types and proper soil reaction to attain would be valuable.



. Reports prior to 1921 (counties)
R Reports prior to 1921 (localities not given)
+ 1921 reports (counties)
* 1921 reports (localities not given

Fig. 82. Distribution of cabbage club root as reported to the Plant Disease Survey, 1903-1921.

Yellows caused by *Fusarium conglutinans* Woll.

Cabbage yellows again ranked as the most important cabbage disease, taking on this year its most serious aspect. A few new infested localities appeared in certain states and there was marked extension of certain other areas. The losses by states are indicated in Table 85.

Table 85. Prevalence of and estimated losses from cabbage yellows, as reported by collaborators, 1921.

State	Estimated loss	Remarks
Vermont	0	Not observed
Rhode Island	0	Not observed
Connecticut	0	Not yet reported from this state
New Jersey	t	One record
Pennsylvania	5%	Becoming more important
Delaware	t	
Maryland	8%	Worst cabbage disease, general over eastern half of state; increasing
Virginia	15%	Worst cabbage disease; prevalent in southwest
West Virginia	t	Locally severe
Kentucky	5%	Less prevalent
Tennessee	t	Serious in some instances
South Carolina	t	Single instance noticed
Louisiana	t	No serious complaints
Texas	20%	Very prevalent
Arkansas	15%	General, serious
Ohio	5%	General, serious
Indiana	4%	Severe in early crop only
Illinois	5%	More prevalent, very important in cabbage growing localities
Michigan	t	Increasing
Wisconsin	9%	More
Minnesota	1%	Locally very important
Iowa	25%	Very serious factor
Kansas	30%	Caused great loss
Montana	.5%	General, not important
Colorado	-	No reports
Washington	-	No reports

Dates of first appearance of cabbage yellows, 1921

May 23	Wyandotte County, Kansas
June 1	Lake County, Indiana
June	Washington County, Ohio
June	Marion, Virginia
July 3	Racine, Wisconsin
September 16	Ramsey County, Minnesota
October 25	Guyencourt, Delaware

The following comments from collaborators are of interest (see also Pl. Dis. Bul. 5: 35, 68, 135. 1921).

Pennsylvania: Cabbage yellows was more serious than usual as a result of the high temperatures over a long period in some sections, notably eastern. (Thurston).

Virginia: Most destructive cabbage disease; 15% reduction in yield. Prevalent in commercial fields in the southwest, which produces one-half the tonnage of the state; 25-30% loss in this section. Wisconsin Hollander and Wisconsin All Seasons very resistant; commercial varieties All Head Early and Copenhagen Market very susceptible. (Fromme).

Kentucky: Very important, when present crop was a complete failure. High temperatures and small rainfall probably influenced severity where present. Less prevalent this year because growers whose fields have shown yellows have stopped planting since they have heard cause of disease. (Valleau).

Ohio: In late cabbage sections industry being reclaimed by the resistant varieties. Early cabbage sections showing greater losses each year. (Thomas).

Indiana: Heat and drouth of June and July made yellows very destructive. Rains late in summer and cooler temperatures checked the disease. Wisconsin Hollander being used in Lake County and All Seasons in Marion County with good satisfaction. (Gardner).

Illinois: Unusually prevalent this year. (Anderson).
Especially in commercial region in Peoria County. (Tehon).

Michigan: Localized, 75 acres reported complete loss. (Coons).

Wisconsin: More prevalent. Important where resistant seed was not used in infested soil, Dane and Grant Counties. Failure of so-called resistant seed indicates liability of error to occur in commercial handling of resistant strains. Wholesale production of Wisconsin All Seasons being handled through cooperation with National Kraut Packers' Association, care of Martin Meeter, Lansing, Illinois. (Vaughan).

Kansas: Eastern and central parts, severe. Test in Butler County showed Wisconsin All Seasons resistant and Early Hollander susceptible. (Stokdyk).

The following as to production of yellows-resistant cabbage seed has been prepared by W. W. Gilbert of the Office of Cotton, Truck, and Forage Crop Disease Investigations:

"The production of yellows-resistant cabbage seed is now being handled on a commercial basis by cooperation through the Wisconsin Experiment Station and the National Kraut Packers' Association. The past season approximately 3600 pounds of seed of Wisconsin All Seasons and about 100 pounds of the Wisconsin Brunswick variety were grown in the Puget Sound District and were distributed to the trade and to State Experiment Stations and experimental services interested.

Arrangements have been made for the continued production of seed of these varieties, and work is being continued looking toward the development of other resistant types to fill the need not met by existing resistant varieties."

J. C. Walker makes the following statement:

"Cabbage yellows was very severe in old cabbage sections in southern Wisconsin, throughout Illinois, Indiana, Ohio, and Virginia.

"Wisconsin Hollander seed was distributed quite widely throughout the trade and in general gave good satisfaction. In a few cases unsatisfactory results were reported, all of these being traced to a single lot of seed which evidently had become adulterated at some time during its growth or distribution. Approximately ten pounds of Wisconsin All Seasons seed was distributed for trial in several states and uniformly excellent results were reported. About 3600 pounds of this variety and 100 pounds of Wisconsin Brunswick were grown in 1921 and distributed to the trade by the National Kraut Packers' Association for use in 1922 and 1923."

Recent literature

Fromme, F. D. The yellows disease of cabbage in southwest Virginia. Virginia Agr. Exp. Sta. Bul. 226: 9 p. Illus. Nov. 1921.

Jones, L. R., J. C. Walker, and W. B. Tisdale. Fusarium resistant cabbage. Wisconsin Agr. Exp. Sta. Res. Bul. 48: 1-34. Fig. 1-10. Nov. 1920.

Black rot caused by Bacterium campestre (Pam.) EFS.

Cabbage black rot caused considerable loss in some areas in 1921. In Wisconsin the loss was estimated at 5% of the crop, and in New York at from 2-5%. Texas and Maryland report a loss of 1%, Minnesota and Delaware .5%. Ten percent damage occurred in some fields in northern Florida in March and April. The following states reported the disease as occurring but of slight importance: Vermont, Rhode Island, Pennsylvania, West Virginia, Michigan, Iowa, North Dakota, South Dakota, and Kansas.

J. C. Walker reported as follows:

"Wherever noted, black rot was quite general when introduced, but confined to certain fields or to the product of certain seed lots in a given field. Evidence all pointed strongly toward introduction on seed."

For collaborators' comments, see Pl. Dis. Bul. 5: 50, 68, 136. 1921.

Blackleg caused by Phoma lingam (Tode) Desmaz.

In general, cabbage blackleg was less destructive in 1921 than in previous years. Walker[1], and Walker and Tisdale[2] confirm previous work as to the importance of rainfall in the development of blackleg on seedlings. At Madison, Wisconsin 65% of the plants showed leaf or stem lesions and at La Conner, Washington, 3%. Comparative rainfall records for May, June, and July, respectively, at Madison were 5.13, 3.52, and 2.46 inches; and at La Conner 1.89, 1.90, and 0.00; thus only a slight development of blackleg occurred at the latter place. It is doubtful whether this amount of disease would have persisted after transplanting. One seed field at La Conner grown from stock seed which developed 75% of blackleg under Wisconsin conditions showed no signs whatever of infection. These results indicate the value of cabbage seed growing in the Puget Sound section to eliminate blackleg.

Table 86. Prevalence of and estimated losses from blackleg of cabbage, 1921.

State	Estimated loss	Remarks
New York	t-1%	Less, too dry while plants were in seedbed
Pennsylvania	-	Eastern part
New Jersey	-	Frequent in southern part
Delaware	.5%	First seen July 10 at Guyencourt
Maryland	1.5%	Less
Virginia	3%	General
West Virginia	t	In Ohio Valley
Louisiana	-	Very slight
Arkansas	10%	General, always severe
Ohio	-	Serious in a few fields
Indiana	.2%	Seen March 18 on plants from Georgia
Wisconsin	5%	Hot water seed treatment most efficient
Minnesota	t	Very light infection found in Wabasha and Ramsey Counties
Iowa	t	

J. C. Walker of the Office of Cotton, Truck, and Forage Crop Disease Investigations reports the disease as very common and destructive in Shocton and Appleton districts, Wisconsin. Found in minor quantities at Racine, Wisconsin; Lansing, Illinois; Clyde, Ohio; and Marion, Virginia.

Recent literature

1. Walker, J. C. Seed treatment and rainfall in relation to the control of cabbage blackleg. U. S. Dept. Agr. Bul. 1029: 1-27. Pl. 1-2. fig. 1. March 28, 1922.
2. Walker, J. C. and W. B. Tisdale. Further notes on occurrence of cabbage blackleg. (Abstract) Phytopath. 12: 43. Jan. 1922.

Black leaf spot caused by *Alternaria brassicae* (Berk.) Sacc.

Black leaf spot was reported as of minor importance in Delaware, Rhode Island, New York (pod spot, less), Texas, Indiana, Illinois, and Wisconsin.

The following table, which should perhaps be interpreted as the "Black rot" of the trade, rather than specifically as black leaf spot is compiled from market inspection reports:

Table 87. Losses from black leaf spot of cabbage caused by *Alternaria brassicae*, as shown by examination of cars at destination by food-products inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	No. of cars with decay	Average percentage decay	Range of percentage of decay: No. cars	Range of percentage of decay: Percent	Remarks
Colorado	1	50	1	50	On outer leaves
Florida	9	14	1	43	
			8	5-27	
Illinois	1	100	1	100	1-3 outer leaves
New York	7	26	1	100	2-4 outer leaves
			3	13-33	
			3	2-5	
Pennsylvania	1	5	1	5	
South Carolina	3	45	3	35-50	
Texas	1	50	1	50	
Unknown	1	95	1	95	2-4 outer leaves

Total number of cars with black leaf spot....... 24
Total number of cars of cabbage inspected....... 828

Gray mold rot caused by *Botrytis* sp.

Table 88. Losses from gray mold rot of cabbage caused by *Botrytis* sp., as shown by examination of cars at destination by food-products inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay: Number of cars	Range of percentage of decay: Percent
Iowa	1	20	1	20#
New York	13	67	5	100*
			7	35-80*
			1	5
Pennsylvania	1	5	1	5*
Wisconsin	3	56	2	75-77*
			1	15*
Unknown	1	50	1	50*

Total number of cars of cabbage with gray mold rot.... 19
Total number of cars of cabbage inspected............. 828

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* Associated with slimy soft rot # Associated with Rhizopus

Other diseases

Downy mildew caused by *Peronospora parasitica* (Pers.) De Bary was reported from New York; Philadelphia County, Pennsylvania; Louisiana; Texas (mostly in seed beds); and Wisconsin. Chupp reports the disease as quite serious on cabbage seed pods in Suffolk County, Long Island, but controlled by Bordeaux with resin-sal soda sticker.

Ring spot caused by Mycosphaerella brassicicola (Duby) Lindau was a controlling factor in California where it caused a 15% reduction in yield of cabbage and other cruciferous plants according to Milbrath. The disease was localized in the San Francisco (Colma) district. The high humidity and low temperature seem significant. W. S. Fields comments on the cold foggy days common in that section as undoubtedly favoring the disease and states that no control measures are practiced.

Peppery leaf spot caused by Bacterium maculicolum McCulloch - reported from Long Island, New York as unimportant.

Slimy soft rot caused by Bacillus carotovorus Jones was reported as unimportant in Vermont, Pennsylvania, Texas, and Wisconsin. It caused slight damage in Minnesota in Wabasha County, and .5% loss in Maryland. A bacterial soft rot caused considerable loss in the late crop in Ohio by rendering the heads unfit for storage or shipping. Slimy soft rot of cabbage was reported generally occurring in carload shipments, but car conditions as to temperature and moisture play such an important role in bringing about development of the rot that data are not given.

Drop caused by Sclerotinia libertiana Fckl. was reported of local importance in West Virginia, Virginia, Louisiana, Texas, and Indiana.

Damping off caused by Rhizoctonia solani Kühn was reported as doing damage in March in seed beds in Sandusky County, Ohio, and at Westville, Connecticut. Clinton states that cabbage is a new host for this organism in Connecticut.

Southern wilt caused by Sclerotium rolfsii Sacc. was reported by Taubenhaus as unimportant in Texas.

Root knot due to Heterodera radicicola (Greef.) Müll. was reported as unimportant in Texas.

Lightning injury occurred at Northford, Connecticut, June 18. Lightning struck ground June 11, injured cauliflower, tomatoes, and lima beans as well as cabbage in the vicinity where it struck. On cabbage, injury often at tips of leaves (probably moisture there attracted electricity directly). (Clinton).

CAULIFLOWER AND BROCCOLI

Club root caused by Plasmodiophora brassicae Wor. was reported from Ohio and Vermont as doing slight damage to the crop in general; and from New York where Chupp reports the disease as important in Suffolk County, causing a reduction in yield ranging from a trace to 2%. Temple reports the greatest loss in western Maryland where a damage of 20% was experienced. (See also cabbage).

Black rot caused by Bacterium campestre (Pam.) EFS. was reported from Ohio as doing slight damage in Wayne, Cuyahoga, Washington, and Lawrence Counties.

Ring spot caused by Mycosphaerella brassicicola (Duby) Lindau - See cabbage.

Head rot of broccoli, thought to be due to bacteria, was reported by Barss from Oregon as follows: "Causes soft decay of head coming into bloom. Destroys flowering. Appears to have a bacterial organism associated as probable cause. Troublesome only in spring on heads carried over for seed production. Reported only from Corvallis. First noticed April 29."

Chlorosis of cauliflower is reported by Dana from King County, Washington.

Lightning injury was reported from Northford, Connecticut, June 18. (See page 364).

BRUSSELS SPROUTS

Blackleg caused by Phoma lingam (Tode) Desmaz. is reported from New York, collected August 30 at Clintondale. (Chupp).

CHINESE CABBAGE

Mosaic (see turnip).

HORSERADISH

Leaf spot caused by Cercospora armoraciae Sacc. collected at Hinton, West Virginia, August 5 by R. J. Haskell.

Leaf spot caused by Ramularia armoraciae Fckl. reported from western Washington.

White rust caused by Albugo candida (Pers.) Ktz. - Collected at Bustleton, Pennsylvania, August 27 by R. J. Haskell.

Bacterial root rot is reported by Poole as causing losses ranging from 4 to 28% on farms near Newark, New Jersey. Storage rot develops to the extent of 25 to 50%. Such roots either fail to germinate or produce stunted plants. Excision of rotted parts and disinfection with bichloride of mercury 1-1000 or formaldehyde 3 pints to 50 gallons for 30 minutes were effective control measures.

Poole, R. F. Bacterial root rot of horseradish in New Jersey. (Abstract) Phytopath. 12: 49. Jan. 1922.

Poole, R. F. Horseradish root rot investigations. Rep. Dept. Plant Path. New Jersey Agr. Coll. Exp. Sta. 1919/20: 610. 1921.

Root rot caused by Rhizoctonia sp. - reported as common in western Washington.

Black streak, cause undetermined, is reported from western Washington by Frank. "This appearance on the stems of the leaves and the mid-veins was again very common. It does not appear during the early part of the season, but in mid-summer and later it is very common."

KALE

Yellows caused by Fusarium conglutinans Woll. is again reported by Gardner as severe in market gardens in Marion County, Indiana, where it was first noted May 20, nearly a month earlier than the first appearance in 1920. The high temperature of June and July is said to be favorable to infection.

KOHL RABI

Club root caused by Plasmodiophora brassicae Wor. was reported from Erie County, New York, August 23.

MUSTARD

Mosaic (see turnip).

RADISH

White rust caused by Albugo candida (Pers.) Ktz. was reported as unimportant in Indiana where it was first noticed May 25; and Colorado where it occurred in August at Fort Collins. It was found as a serious disease in greenhouse radishes at Saginaw, Michigan, on February 9.

Downy mildew caused by Peronospora parasitica (Pers.) De Bary was reported as unimportant in Indiana, although it attacked the leaves of plants in hotbeds severely. It was first noticed at Indianapolis on April 27.

Club root caused by Plasmodiophora brassicae Wor. was found by Barrus on August 23 in one garden in Erie County, New York.

Black root caused by Rheosporangium aphanidermatus Edson[1] has been reported in the records of the Survey as follows:

Illinois: Present in 9 counties, doing 25-100% damage. (Barrett, 1911). (Under name Aphanomyces laevis De Bary) 1911 and 1912.
Indiana: (Aphanomyces laevis) reported 1911, 1912, 1914, 1916, 1917; (Rheosporangium) 1919 - fairly common, doing some damage.
Michigan: Reported from Lansing, 1912 (not named).
New York: (Aphanomyces) Specimen received from Long Island, 1912.
Wisconsin: (Aphanomyces) Specimen found May 1913 in University Garden, reported same year from Fond du Lac, Oshkosh, and Geneva.
Mississippi: Seventy to ninety percent infection in one field at Long Beach, May 3, 1919.

Edson[1] gives the following range for the black root of radish: District of Columbia, Maryland, Virginia, Long Island, and several points in Wisconsin. In this reference it is also pointed out that the fungus is pathogenic to beet seedlings.

Reports for 1921 extend the known range of this disease to Pennsylvania, where Thurston and Orton report heavy loss to radishes both under glass and out of doors in York County. Gardner and Kendrick report the disease as worse in Indiana and very destructive on both early and late season white varieties, reducing the yield for the state .5%. It seems to be most severe in central Indiana. The cool temperatures of early spring and late fall favor the disease. It is worst on Icicle varieties, but was noted on Early Long Scarlet, Early Vienna, and Cincinnati Market. (See also sugar cane root rot).

1. Edson, Howard Austin. Rheosporangium aphanidermatus, a new genus and species of fungus parasitic on sugar beets and radishes. Jour. Agr. Res. 4: 279-292. Pl. 44-48. July 1915.

RUTABAGA

Black rot caused by Bacterium campestre (Pam.) EFS. was reported by Vaughan as more important than usual in northern Wisconsin. The reduction in yield was estimated at 1%.

TURNIP

Mosaic was reported simultaneously on turnip by Gardner and Kendrick and on Chinese cabbage, mustard, and turnip by Schultz. The disease is infectious and is transmitted by plant juice (rubbing) and by aphids (Myzus persicae Sulz.). Gardner was not able to infect radishes with the virus. In his report to the Survey, he states that it was not of common occurrence on turnips in Indiana in 1921. The roots of mosaic plants are stunted. The disease was noticed first on turnips on July 26 at Lafayette, but the related mosaic on wild mustard was observed as early as April 25 at Indianapolis.

Gardner, M. W. and J. B. Kendrick. Turnip mosaic. Jour. Agr. Res. 22: 123-124. Pl. 20. Oct. 15, 1921.

Schultz, E. S. A transmissible mosaic disease of Chinese cabbage, mustard, and turnip. Jour. Agr. Res. 22: 173-178. Col. pl. B, pl. 22-24. Oct. 15, 1921.

Downy mildew caused by Peronospora parasitica (Pers.) De Bary was reported again from Texas.

White rust caused by Albugo candida (Pers.) Ktz. was reported as prevalent in Texas.

Anthracnose caused by Colletotrichum higginsianum Sacc. was reported as unimportant in Oconee County, South Carolina, where it was first seen October 13.

Powdery mildew was reported from Goshen, Indiana.

Alternaria leaf spot was reported from Goshen, Indiana by Gardner.

Yellows caused by Fusarium conglutinans Woll. - found destructive in a market garden at Lafayette, Indiana.

Club root caused by Plasmodiophora brassicae Wor. - reported from Jefferson County, Pennsylvania.

DISEASES OF CUCURBITS

CANTALOUPE

Leaf blight caused by Alternaria brassicae nigrescens Pegl.

Leaf blight was reported from Pennsylvania, Delaware, Maryland, Texas, Indiana, Illinois, Michigan, and Missouri. All states except Maryland, Michigan, and Missouri report the disease as serious. In Texas it caused a loss estimated at 1%. It was observed on July 19 in Indiana and August 9 in Delaware. In the latter state control has been secured with both Bordeaux mixture and Bordeaux dust. Gardner reports that the disease is severe in Indiana where rotation is not practiced, which is probably true in all melon growing areas. Rotation along with seedbed sanitation would doubtless completely handle the situation, providing seed transfer does not occur. However, it is the prevailing practice among growers to follow melons with melons. Given frequent summer rains, infection from trash makes blighting severe. Many sections are using resistant varieties. E. A. Bierbaum, Assistant

County Agent of Union County, Anna, Illinois, reports that growers are planting Pollock melons, particularly the strains known as "Ten" and "Ten Twenty-five". "These have been found to be more or less rust resistant and are meeting with fairly good success. Hearts of Gold and Netted Gem are also used, but our men are taking stronger every season to the Pollock melons." P. K. Blinn, Rocky Ford, Colorado states, "I feel safe in the assertion that practically nine-tenths of all the cantaloupes in the great commercial cantaloupe growing districts are planted with seed of some strain selected from the original disease-resistant Pollock cantaloupe. The Rocky Ford Cantaloupe Seed Breeders' Association have over 1500 individual plant selections of the most highly resistant and most uniform producing types."

Bacterial wilt caused by Bacillus tracheiphilus EFS

Bacterial wilt was reported from New York, Pennsylvania, Maryland, Virginia, West Virginia, Tennessee, North Carolina, Indiana, Illinois, Michigan, and Missouri. New York, Pennsylvania, Maryland, Virginia, Michigan, and Missouri report, in general, slight loss to the state, but occasional outbreaks. On the other hand, in West Virginia Giddings estimates the loss at 25% of the crop, and in North Carolina Foster states that the disease is fairly destructive. Clayton states that the disease has been severe and losses were heavy in Ohio. In Indiana, where the disease first appeared June 28, Gardner estimates the loss at 3% of the crop. The checking of the disease by hot weather, which has been noticed before and which may be associated with the low thermal death point of the organism, is indicated as operative in this report from Thomas in Ohio: "Comparatively slight evidence of the disease has been noticed since the first of August."

Anthracnose caused by Colletotrichum lagenarium (Pass.) Ell. & Hals.

Anthracnose was of slight importance in New Jersey, Pennsylvania, Tennessee, North Carolina, Ohio, Indiana, and Wisconsin. Burger believed the disease to be about as usual in Florida, although he had no reports of it. On the other hand, Melchers reported the disease as quite common on the foliage, causing death of the vines in Kansas. In West Virginia the disease was said to be general and more prevalent than in the average year, but only locally severe. Only one collection on a volunteer plant was made in Indiana at Mooresville, September 15. In Colorado, according to Learn, anthracnose was reported from near Denver, where it had caused the loss of about half the crop of two growers.

Mosaic (cause undetermined)

In reply to the August 15 questionnaire, collaborators in West Virginia, North Carolina, South Carolina, Ohio, and Kansas reported cantaloupe mosaic as "unreported to date", and in New Jersey as "unimportant." In Delaware, which is the only eastern state reporting the disease as important, mosaic is general and increasing in prevalence, producing a loss of 15% according to Adams. In Pennsylvania, Indiana, and Wisconsin the disease is considered to be of minor importance. Milbrath reports the reduction in yield for a district of 2500 acres in the San Joaquin Valley, California, at 45%. The disease has shown a periodicity there, being very severe in 1919, not occurring at all in 1920, and with a serious outbreak during the past season. E. A. Bierbaum at Anna, Illinois states that a campaign is being conducted this spring (1922) to destroy all wild cucurbits and milkweeds in that vicinity as well as for better control of the striped cucumber beetles and melon lice. This is an experimental measure, based upon Doolittle's findings that the perennial wild plants harbor the mosaic virus and that this virus is brought to the cultivated fields by insects.

Fruit rot caused by Fusarium spp.

Anderson reports the late crop especially badly affected on account of the wet fall in Illinois. In Indiana Gardner reports rotting by Fusarium invading growth cracks due to the late growing season.

The following record of decay in shipments is probably concerned with the same type of trouble:

Table 89. Losses from Fusarium rot of cantaloupe caused by Fusarium spp., as shown by examination of cars at destination by inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	
			Number of cars	Percent
Arkansas	7	4	7	1-10
California	8	17	1	65
			7	1-25
Colorado	1	2	1	2
Florida	2	11	2	3-19
Indiana	3	17	3	2-30
Maryland	1	2	1	2
Nevada	1	20	1	20
North Carolina	3	19	3	4-35
Unknown	2	4	2	4-5

Total number of cars with Fusarium rot.............. 28
Total number of cars of cantaloupes inspected....... 231

Rots caused by various organisms

Various decays are the cause of heavy losses in cantaloupes under transportation conditions. The significance of the rots in the field is largely unknown or disregarded. Under shipment conditions, bruised, delayed, or over-ripe fruit shows severe shrinkage as is shown in the following table; which gives the losses reported by food-products inspectors of the Bureau of Markets and Crop Estimates as due to Rhizopus sp.; to green mold rot caused by Cladosporium sp.; to black mold rot caused by Alternaria sp.; and to bacterial soft rots.

Table 90. Losses to cantaloupes in transit from various rots as reported by inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	Approximate No. cars inspected	Amount of decay							
		Rhizopus		Green mold rot		Black mold rot		Bacterial soft rot	
		No. cars	Per cent	No. cars	Per cent	No. cars	Per cent	No. cars	Per cent
Arizona	9	1	2	-	-	-	-	-	-
Arkansas	18	6	21	-	-	-	-	1	10
California	102	7	6	4	23	3	16	2	13
Colorado	12	-	-	-	-	-	-	1	2
Delaware	6	-	-	-	-	-	-	-	-
Florida	3	1	1	-	-	-	-	-	-
Georgia	8	2	33	-	-	-	-	-	-
Indiana	5	-	-	-	-	-	-	-	-
Maryland	1	-	-	-	-	-	-	-	-
Missouri	2	-	-	-	-	-	-	-	-
Nevada	1	-	-	-	-	-	-	-	-
New Mexico	1	-	-	-	-	1	43	-	-
North Carolina	25	5	8	-	-	1	20	1	10
Ohio	1	-	-	-	-	-	-	-	-
South Carolina	18	7	8	-	-	1	2	-	-
Texas	5	1	1	-	-	-	-	1	8
Unknown	14	2	31	1	4	1	60	-	-
Total	231	32		5		7		6	

Other diseases

Downy mildew caused by Pseudoperonospora cubensis (B. & C.) Rostow - was reported as general in Sussex and Kent Counties, Delaware, being first seen in July at Delmar. The warm, showery, humid weather which prevailed in the state in the first half of July may have been a factor in making the downy mildew severe. Sherbakoff found the disease at Chattanooga, Tennessee August 11. The disease was found at Poplarville, Mississippi in July, causing extensive defoliation in the field and was also observed on the College grounds.

A bacterial leaf spot (undetermined) was reported from Columbia County, New York by Chupp.

Leaf spot caused by Cercospora cucurbitae E. & E. was reported as prevalent in Sussex and Kent Counties, Delaware, appearing at Delmar in July, the first report for the state. Always observed accompanying leaf infection by downy mildew (Adams).

Fruit rot caused by Cladosporium cucumerium El. & Arth. caused 2% loss in Honey Dew melons, in California, according to Milbrath.

Wilt caused by Fusarium spp. was reported from a wider range of territory than in 1920. In California the loss was estimated at 2%, the disease being prevalent in Stanislaus, Merced, and Modesto Counties (Milbrath). Brown reports the disease from Nogales and St. David, Arizona on June 7 and July 23.

Hopkins considers the disease to be increasing in importance in Missouri. Adams reports slight loss at Milton, Delaware, July 18.

Sclerotium blight caused by *Sclerotium rolfsii* Sacc. was reported as unimportant in Texas.

Root knot caused by *Heterodera radicicola* (Greef) Müll. was reported as unimportant in Texas, but in the Imperial Valley, California, severe infestation existed in certain districts, causing a reduction in yield for the state of 5%. The range of loss was from .5% to 60% and when it is considered that 21,000 acres of melons were grown in this Valley, the aggregate loss is enormous.

Copper dust injury. Considerable burning of the vines was experienced in Delaware as a result of heavy applications of Bordeaux dust. The vines recovered but were two weeks late. (Adams).

CUCUMBER

Bacterial wilt caused by *Bacillus tracheiphilus* EFS

Collaborators in Connecticut, New York, Maryland, North Dakota, and California report bacterial wilt as of very slight importance in 1921. On the other hand, it is said to be the worst disease of cucumbers in West Virginia and Indiana, and was reported as severe in Wisconsin, Iowa, and Kansas. It caused considerable damage in Ohio also and was prevalent in Texas. Table 91 gives the losses from and prevalence of the disease.

Table 91. Relative prevalence of and estimated losses from bacterial wilt of cucumber, as reported by collaborators, 1921.

State	Importance 1921	Prevalence compared with		Range	Percent loss	Reported by
		1920	Av. year			
Connecticut	One complaint	More	Average	-	-	Clinton
New York	Not important	Less	-	With crop	t	Chupp
Maryland	-	-	-	-	t	Jehle & Temple
West Virginia	Most important disease	More	More	General	10	Giddings
Texas	Prevalent	-	-	-	1	Taubenhaus
Ohio	Considerable	About same	Same	General	-	Thomas
Indiana	Worst disease	Same	Same	With crop	5	Gardner
Illinois	Severe	-	-	Northern; general	-	Doolittle
Michigan	Severe	-	-	-	-	Doolittle
Wisconsin	Serious	More	More	General	2	Doolittle
Iowa	-	Same	Same	-	12	Melhus
North Dakota	Unimportant	About same	Same	-	-	Weniger
Kansas	Serious	-	-	Eastern	-	Melchers
California	Slight	Slight	Slight	-	.1	Milbrath

S. P. Doolittle, who watched cucumbers closely again this summer, makes the following report concerning bacterial wilt:

> "Bacterial wilt was unusually severe in Wisconsin and northern Illinois and for the first time in the last five years was of serious economic importance in these states. The disease was found in all fields examined and the average infection was from 5 to 8% or about 100% greater than in 1920. A few fields showed a maximum infection of from 20 to 30% and the losses throughout the state of Wisconsin were sufficient to probably reduce the crop 2%. The disease appeared about July 1, and continued to spread rather rapidly up to August 15. Reports from Indiana and Michigan indicated a similar situation in these states."

Dates of first observed appearance of bacterial wilt of cucumber, 1921

June 2..................	Wyandotte County, Kansas
June 22.................	Wood County, Ohio
July 1..................	Wisconsin
July 7..................	Lafayette, Indiana
August 8................	Branford, Connecticut

The suggestion made by Rand and by others that the striped cucumber beetle carries the wilt organism through the winter has been confirmed by Doolittle[1].

Recent literature

1. Doolittle, S. P. Overwintering of the bacterial wilt of cucurbits. Phytopath, 11: 299-300. 1921.

_______________ Comparative susceptibility of European and American varieties of cucumbers to bacterial wilt. Phytopath. 12: 143-146. March 1922. (June).

Mosaic (cause undetermined)

Cucumber mosaic was reported from Maryland, Texas, Illinois, Iowa, North Dakota, and Michigan as being less severe than in previous years.

S. P. Doolittle summarizes the condition regarding cucumber mosaic in the central pickle growing areas in 1921 as follows:

> "The average losses from cucurbit mosaic in Wisconsin and Illinois appeared to be approximately 70% of those of average years and not more than 50% of those in 1920. About 60% of all fields examined showed the disease, but owing to its slow dissemination during 1921, many fields were not infected until late. The infection varied from a trace up to 100% in individual fields. The average number of plants infected on September 1 was probably about 30%. The reduction in the injury from mosaic was partly due to the reduced number of aphids in most sections where they were numerous in 1920. Observations over a number of seasons have shown that the injury from mosaic fluctuates directly with the presence or absence of this and other cucumber insects. Losses in Wisconsin were probably

about 12% from mosaic. Reports from Michigan and Indiana indicated some reduction in injury as compared with 1920."

Table 92. Relative prevalence of and losses from cucumber mosaic, 1921.

		Prevalence compared with		Percent	
State	Importance	1920	Av. year	loss	Reported by
New York	Very important especially on Long Island	As much or more	-	25-50	Chupp
Maryland	-	-	-	t	Jehle & Temple
Texas	Unimportant	-	-	-	Taubenhaus
Indiana	Serious factor	Less	Less	2	Gardner
Illinois	Important	Less	Less	-	Doolittle
Michigan	-	Probably less	-	2	Doolittle, Coons
Wisconsin	Important	Much less	Much less	12	Doolittle
Iowa	-	Less	-	5	Melhus
North Dakota	Locally destructive	Same	About same	-	Weniger
California	Severe in greenhouses	-	-	3-5	Milbrath

W. W. Gilbert reports 100% infection in cucumber fields on the Arlington Experimental Farm in Virginia. Chupp reports the disease as very important in New York, being especially serious on Long Island, beginning to show when plants are ten days old, and being found in as high as 100% prevalence in some fields. He quotes a report of his office as follows: "Two-thirds of the crop lost in Nassau County. Farmers are quitting the growing of pickles."

M. B. Church[1] reports the results of preliminary work which indicates that mosaic affected cucumbers will not cure properly in the pickling process.

Doolittle and Walker[2] state that mosaic milkweeds are an evident source of primary infection in cucumber fields. Cross-inoculation experiments indicate a possible transmission of cucurbit mosaic to the potato by means of aphids. Aphids taken from the potato plants so inoculated produced mosaic symptoms on cucumbers. Mosaic-cucumber aphids transferred to healthy pokeweed plants produced symptoms of mosaic in three out of five cases. The results of these transmission experiments give indication that some very interesting developments are to be expected from further work.

Recent literature

1. Church, M. B. The relation of mosaic disease to pickling of cucumbers. Phytopath. 11: 28-29. Jan. 1921 (Febr.).
2. Doolittle, S. P. and M. N. Walker. Notes on cucurbit mosaic. (Abstract) Phytopath. 12: 42-43. 1922).

Angular leaf spot caused by Bacterium lachrymans EFS. & Bryan

This disease of cucumber, which is not known to occur on watermelon, squash, or muskmelon, occurs in North America and Europe. It has been reported from Alabama, California, Colorado, Connecticut, Florida, Georgia, Illinois, Indiana, Iowa, Louisiana, Michigan, Minnesota, New York, North Dakota, Ohio, South Carolina, Virginia, Wisconsin, and is found also in Ontario and Quebec (Meier and Link).

In 1921 the disease was reported from Florida, Indiana, Illinois, Michigan, Wisconsin, Iowa, and California. In general, it was less important than usual, although it caused considerable fruit rot late in the season, in some localities.

S. P. Doolittle makes the following statement regarding the disease in the Middle West:

> "Angular leaf spot did not appear in Wisconsin and northern Illinois until about July 25. In southern Wisconsin it did little serious damage as it did not develop to any extent until the season was nearly over. Reports from central and northern Michigan and northern Wisconsin, however, indicated that in some sections the disease was causing a serious rotting of the fruits in a number of fields. The average infection noted was from 5-25% with about 35% of the fields infected by August 25."

Drechsler and Meier (Cotton, Truck, and Forage Crop Disease Investigations News Notes, March 2, 1921) report the disease as widespread in cucumber-growing sections of Florida and as particularly serious where overhead irrigation is practiced. The season has been exceptionally warm. Gardner reports the disease unimportant in Indiana and states that seed treatment has practically eliminated the disease from the crop of a large pickling company. Coons found the disease causing heavy loss in Michigan, especially in producing secondary fruit rots at a seed farm. In Iowa 2% loss was incurred according to Melhus. Milbrath says that the disease was severe on Klondike variety in San Diego County, California, 30% of the plants being affected severely.

Jones and Doolittle[2] give additional evidence of seed transference of the organism and record destructive action on the young fruit in the field. Gardner and Gilbert[1] report the results of additional tests demonstrating the effectiveness of control by seed disinfection with mercury bichloride, 1-1000, for five minutes. Soil infestation did not occur and is believed not to be a factor. Two-year old seed cannot be considered free from this organism, but three-year old seed apparently does not carry the infection.

Recent literature

1. Gardner, M. W. and W. W. Gilbert. Field tests with cucumber angular leaf spot and anthracnose. Phytopath. 11: 298-299. July 1921 (Nov.).
2. Jones, L. R. and S. P. Doolittle. Angular leaf spot of cucumber. Phytopath. 11: 297-298. July 1921. (Nov.)

Anthracnose caused by Colletotrichum lagenarium (Pass.) Ell. & Hals.

Apparently anthracnose was again of small consequence. Doolittle reported as follows:

> "Found in only a few fields in Wisconsin and Illinois, not over 5% of the fields affected and about 2-10% of the plants in these fields affected with the disease. Reports of serious losses in two

fields in northern Wisconsin and one in Michigan were received, the crop being reduced about 10% in these cases."

Only one report of this disease was received from New York, its damage in Maryland was but a trace, and in Iowa none was found. For West Virginia, Giddings reported more of the disease present than last year with a reduction in yield of 1% for the state. The disease was worse than usual in Indiana, being influenced by late rains. Anthracnose did a great deal of damage with the late maturing seed crop of cucumbers in Michigan, causing 50% loss to the seed crop in one locality, according to Coons.

Gardner and Gilbert (l. c., see angular leaf spot) report that the fungus did not persist twenty months in soil and that a two-year rotation would eliminate anthracnose soil infestation.

Downy mildew caused by Pseudoperonospora cubensis (B. & C.) Rostow

This disease was present to a very slight extent in Connecticut, Maryland, Ohio, and Wisconsin, but was not found in Illinois, Indiana, and Michigan. It was stated by Ludwig to be important locally in South Carolina. In Wisconsin the disease was found in two fields at Rockland, Monroe County, just appearing August 25, according to Doolittle.

Black rot caused by Mycosphaerella citrullina (C.O.Sm.) Gros.

Meier, Drechsler, and Eddy[1] report a fruit decay due to Mycosphaerella citrullina which is known as occasionally destructive to greenhouse muskmelons and watermelons in the southeast, but which has not previously been reported on cucumbers. Affected cucumbers develop water-soaked areas, which, although enlarging less rapidly than those caused by Rhizopus sp., may attain considerable size during the time required for transportation. (See also under squash).

1. Meier, Fred, Charles Drechsler, and Emery Eddy. Cucumber black rot caused by Mycosphaerella citrullina. (Abstract) Phytopath. 12: 43. 1922.

Scab caused by Cladosporium cucumerinum Ell. & Arth.

Scab was reported from New Hampshire, Michigan, Wisconsin, and California. It seemingly was of importance only in the northern half of the Lower Peninsula of Michigan and there it assumed importance rather from peculiar trade conditions than from actual crop destruction. "The favorable season led to the production of a heavy crop of cucumbers and in some areas at the first outbreak of scab certain packers sought to refuse to purchase any of the crop and carry out their contracts with growers. This disease, therefore, indirectly led to a loss to farmers of approximately $2,000,000." (Coons).

S. P. Doolittle makes the following report:

> "Scab was reported from Jackson and Marinette Counties in Wisconsin and from Grand Traverse County, Michigan, in all of which

localities it appeared to be causing some damage. The disease was not found at other points and apparently was of little economic importance over these states in general."

Fruit rots caused by various organisms

Various decays, which were found on cucumbers in transit, are reported in Table 93.

Table 93. Losses to cucumber from Rhizopus rot caused by Rhizopus sp., bacterial spot caused by Bacterium lachrymans, and soft rot (cause undetermined), as reported by inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	Approximate No. cars inspected	Amount of decay					
		Rhizopus		Bacterial spot		Soft rot	
		Number cars	Per cent	Number cars	Per cent	Number cars	Per cent
Alabama	12	-	-	6	2	-	-
Arkansas	1	-	-	-	-	-	-
California	3	-	-	-	-	-	-
Delaware	2	-	-	1	1	-	-
Florida	43	6	9	22	13	11	6
Georgia	2	-	-	-	-	1	3
Illinois	1	-	-	-	-	-	-
Louisiana	5	-	-	-	-	1	12
Maryland	9	1	2	2	3	1	7 W
Michigan	1	1	8BS	1	8R	-	-
Mississippi	1	-	-	-	-	-	-
New York	2	-	-	-	-	-	-
North Carolina	23	1	2	3	11	5	6
Ohio	1	-	-	1	13M	-	-
South Carolina	16	-	-	7	14	3	5
Texas	6	1	5P	-	-	1	1
Unknown	9	-	-	3	7	1	5BS
Totals	137	10		46		24	

BS Associated with bacterial spot
M Mostly black rot (Mycosphaerella)
W Associated with white mold rot
P Some Phoma rot
R Associated with Rhizopus rot

Other diseases

Sclerotinia rot caused by Sclerotinia libertiana Fckl. was reported from Idaho (unimportant, noted in gardens after fall rains began - Hungerford) and California (in greenhouses during the period of January to June, causing .5% loss - Milbrath).

Root knot caused by Heterodera radicicola (Greef) Müll. was serious in greenhouses in Illinois and Pennsylvania; and occurred in the field in Texas.

Chlorosis was reported by Dana as occurring in Washington.

GOURD

Downy mildew caused by Pseudoperonospora cubensis (B. & C.) Rostow was reported by Gardner as occurring on one plant at Akron, Indiana, September 21.

Anthracnose caused by Colletotrichum lagenarium (Pass.) Ell. & Hals. was reported by Anderson of Illinois as very serious on a variety of edible gourds grown in University plantings. It occurred both as a fruit spot and a rot.

SQUASH

Bacterial wilt caused by Bacillus tracheiphilus EFS. was reported as doing slight damage in New York (observed 2 acres of Hubbard squash with 10% loss, at Chautauqua, July 25 - Chupp), Ohio (more; loss considerable with some growers; in northern half of state; greatest losses noted in storage, presumably due to late infection. - Thomas), Indiana, and Iowa.

Anthracnose caused by Colletotrichum lagenarium (Pass.) Ell. & Hals. was reported from Ohio.

A storage rot due to Gloeosporium sp. (not C. lagenarium) was found in local stores on the 1920 crop in Indiana, according to Gardner.

Downy mildew caused by Pseudoperonospora cubensis (B. & C.) Rostow was important locally in South Carolina. (Ludwig).

Leaf spot caused by Macrosporium cucumerinum E. & E. was reported from Genesee County, New York as important locally. (Chupp).

Mosaic was reported as unimportant in Texas. (Taubenhaus).

Black rot caused by Mycosphaerella citrullina (C.O.Sm.) Gros. - Kauffman, C. H. A black rot of squash. Rep. Mich. Acad. Sci. 22(1920): 201-202. 1921.

WATERMELON

Anthracnose caused by Colletotrichum lagenarium (Pass.) E. & H.

Watermelon anthracnose, which in 1920 was known largely from market inspectors reports, is in 1921 reported to be of considerable importance in certain northern as well as southern states. In addition to those whose comments are quoted below, collaborators in Mississippi, Louisiana, and Texas report the disease. (See also Pl. Dis. Bul. 5: 118-119. 1921.)

New Jersey: Abundant, but crop of little importance. (Cook).

Delaware: Very important; general; leaf infection more common than fruit. (Adams).

Maryland: Less prevalent, reducing yield 5%. (Jehle and Temple).

Virginia: No doubt general. (Fromme).

Table 94. Losses from watermelon anthracnose caused by Colletotrichum lagenarium (Pass.) E. & H., as shown by examination of cars at destination by inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	
			Number of cars	Percent
Alabama	2	18	2	15-20
Arkansas	3	12	3	10-15
Florida	21	20	2	80-95
			3	30-40
			6	10-25
			10	2-8
Georgia	183	30	18	75-100
			27	50-74
			40	25-49
			89	5-24
			9	1-4
Indiana	14	22	4	35-65
			6	10-30
			4	3-7
Missouri	1	35	1	35
North Carolina	8	25	1	75
			6	10-35
			1	3
Ohio	1	7	1	7
Oklahoma	1	10	1	10
South Carolina	145	28	10	75-100
			17	50-70
			41	25-49
			73	5-24
			4	1-4
Texas	1	50	1	50
Unknown	7	21	1	30
			5	15-25
			1	2

Total number cars watermelons with anthracnose....... 387
Total number cars watermelons inspected............. 994

West Virginia: Quite general, but severe only locally, loss to state 2%. (Giddings).

Tennessee: In certain fields very damaging. (Essary, Sherbakoff, and Hesler).

North Carolina: Important in Coastal Plain section. (Foster).

South Carolina: Of moderate importance in southwestern portion. (Ludwig).

Georgia: It was reported that watermelon anthracnose was unusually bad on early melons in southern Georgia. Later the dry weather seemed to check the disease. (Higgins).

Florida: Less than last year, about same as usual. General. Most important from May 15 to June 15. (Burger).

Arkansas: Severe in some fields, mostly leaf spot, some on fruits. Loss to the state, 5%. (Elliott).

Ohio: Slight, worse in southern section of the state. (R. C. Thomas).

Indiana: Very important, much worse than last year or than usual. Favored by excessive rainfall. Worse in central Indiana where season extended into rains of late summer. Most important in August, when fruit was maturing. (Gardner).

Missouri: Known to be general. (Hopkins).

Kansas: Important in some regions. Severe foliage infection caused crop to sunscald. In Riley County about 50% of the crop was lost. There was more moisture in July and August than normal. (Melchers).

Colorado: Present, important about Denver. (Learn).

Arizona: Present in southern Arizona. (Brown).

Supplementing the above reports by collaborators, the accompanying table (Table 94) compiled from market inspectors' reports is worthy of consideration. Even when field losses are reported as low, carlot shipments frequently showed from 75-100% decay from this cause upon arrival at northern markets. Out of nearly a thousand cars inspected, 25% showed upon the average 26% decay from this cause. It is very evident from this showing that watermelon anthracnose presents problems in disease control well worthy of attention.

The following report on dusting experiments with watermelon has been furnished by H. A. Cardinell. These tests seem to indicate that there is considerable promise in this method of control.

> "The test was conducted with dehydrated copper sulphate and hydrated lime, used at a ratio of 1 to 4, using 9 pounds of the mixture to the row*.
>
> "Applications made when the first melons were set and when the fruit was full grown, gave 12 melons in 8 rows with an average of 1 lesion of anthracnose per melon. The check, on the other hand, showed 24 badly spotted melons per row.
>
> "Dry Bordeaux applied in various strengths gave fair control with four applications and no control with 2 applications.
>
> "These trials with copper dusts did not give as good control as has been obtained in other states where four to nine applications of liquid Bordeaux have been made, but this one season's trial showed that good control might be expected had more applications been made."

Recent literature

Burger, O. F. Watermelon diseases. Quart. Bul. State Plant Bd. Florida. 5: 131-138. Illus. April 1921.

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* Experiments were with watermelons set 10 x 10 feet, 32 plants to the row. Yields were not taken. (Missouri).

Stem end rot caused by Diplodia Sp.

Stem end rot was not found in New Jersey, West Virginia, or South Carolina, and was reported for the most part as of slight importance in North Carolina, Maryland, Mississippi, Texas, and Louisiana. The disease is evidently present in the fields and develops to serious proportions in transit. Adams reported the disease as first observed in Delaware August 2 and as "very prevalent in early planted fields, being more common on new ground. Some fields showed 5% infection." Melchers reported the disease as occurring to some extent in most fields in Kansas. Neal believes the disease to have been checked in Mississippi by dry weather. Jehle and Temple estimated the loss as 1% in Maryland. Taubenhaus states that the disease was not important in Texas. Elliott places the loss in yield for Arkansas at 3%. Burger reports the disease as occurring in the field in Florida, but causing greatest loss during shipment. Where the stems of the melons were properly treated there was very little rot in transit, (see also Pl. Dis. Bul. 5: 119. 1921).

Table 95. Losses from stem end rot of watermelon caused by Diplodia sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	
			Number of cars	Percent
Alabama	2	11	2	7-15
Arkansas	3	10	3	6-15
Florida	61	12	3	50-85
			7	20-45
			26	5-18
			25	1-4
Georgia	354	12	2	75-100
			23	35-60
			233	5-33
			96	1-4
Indiana	29	4	29	1-10
Kentucky	1	50	1	50
Mississippi	2	15	2	6-25
Missouri	1	8	1	8
North Carolina	18	9	7	12-25
			11	1-8
Ohio	1	6	1	6
Oklahoma	1	6	1	6
South Carolina	118	15	6	50-80
			17	24-45
			73	5-23
			22	1-4
Texas	12	11	6	12-25
			6	2-5
Virginia	2	18	2	2-35
Unknown	22	7	10	8-20
			12	2-5

Total number cars of watermelons with stem end rot...... 627
Total number cars watermelons inspected................. 994

F. C. Meier of the Office of Cotton, Truck, and Forage Crop Disease Investigations, conducted laboratory tests with various fungi associated with melon decay in the field, but secured no decay except with Diplodia. Infection was not secured with Diplodia without wounding the melons. Stem treatment tests were made which showed that where treatment was properly applied no decay resulted. A possible explanation of decay present last season in cars that showed evidence of treatment was found in the fact that six hours after inoculation the fungus penetrates the stem to a point where the fungicide paste is not effective. Very few growers last season followed instructions with regard to recutting the stem at the time of treatment.

With this disease, to a greater extent even than with anthracnose, the field aspects are enormously magnified when market conditions are considered. Out of nearly a thousand cars inspected at terminal markets, 627 or 63% were badly injured through this type of decay, the average percentage of decay being 13.

Blossom end rot (cause unknown)

Various fungi are known to bring about this condition, and it is suspected that weather blighting is also a factor and that many of the fungi isolated are secondary invaders. Diplodia spp., Fusarium spp., and Pythium sp. are reported by various collaborators as causal agents. The name, evidently, describes a general condition embracing several different types of disease. Adams reports blossom end rot, not connected with Diplodia, appearing August 2 at Bridgeville, Delaware. Valleau reports the disease as present in Kentucky. Taubenhaus reports the disease as prevalent in Texas, doing 1% damage; Elliott places the loss at 5% for Arkansas; Melhus states the loss for Iowa is 2%; and Hungerford notes the disease as present in the Lewiston district, Idaho.

Wilt caused by Fusarium niveum EFS.

Fusarium wilt was reported in 1921 as unimportant in Maryland and Mississippi, as locally important in Virginia, West Virginia, North Carolina, Illinois, and Iowa, and as general and important in Indiana, Missouri, and Texas. It was very destructive in some sections of North Carolina according to Foster, but as a rule infested soil has been abandoned for melon culture. In West Virginia Giddings states that the disease was seen only in the Ohio Valley where it was more severe than usual, reducing the yield 1% and being especially severe on light soils. The disease was less severe according to Gardner in central and southern Indiana because of low temperatures associated with excessive rains, but nevertheless it is the limiting factor in watermelon growing. Anderson reported it as serious in some localities of Illinois. It was reported by Melhus as local but serious where it occurs in Iowa. Hopkins considers the disease very important in Missouri and more severe than in the preceding year.

Dates of first appearance of watermelon wilt

May 30......	Missouri	June 28.....	Woodford County, Ill.
June 28.....	Vincennes, Indiana	August 8....	Lilburn, Powhatan Co., Va.

Other diseases

Downy mildew caused by *Pseudoperonospora cubensis* (B. & C.) Rostow was reported as very important and general in Sussex and Kent Counties, Delaware. It first appeared at Delmar in July. (Adams).

Leaf blight caused by *Alternaria brassicae nigrescens* Pegl. was reported by Adams as first observed in Delaware August 2. It was generally prevalent but did not develop serious infection as found on cantaloupes.

Leaf rot caused by *Cercospora citrullina* Cke. was reported from Texas.

Wilt caused by *Bacillus tracheiphilus* EFS. was reported from Kentucky as severe in the vicinity of Lexington. Raeder reported it as important in the melon growing regions of Idaho, causing a distinct wilting and killing of the plants. Milbrath states that it is an important factor in Los Angeles County, California, and estimates a 2% reduction in yield for the state.

Root rot caused by *Rhizoctonia* sp. was reported by Dana from Asotin County, Washington.

Root knot caused by *Heterodera radicicola* (Greef) Müll. was reported by Milbrath as occurring in the Imperial and San Joaquin Valleys, California, and causing a reduction in yield for the state of .5%.

DISEASES OF COTTON

Anthracnose caused by *Glomerella gossypii* (Southw.) Edg.

Anthracnose was reported, in general, as less severe in 1921 than in the preceding year; the dry, hot weather of the summer serving to restrict spread and prevent serious loss in many areas. In North Carolina the disease was said to be common only in the southeastern portion, where rainfall was abundant. In years of abundant moisture, anthracnose is an important disease in the Delta section of Mississippi, according to Neal, but dry weather prevented its becoming so this year.

Table 96. Relative prevalence of and losses from cotton anthracnose, as reported by collaborators, 1921.

		Prevalence compared with:			Percent
State	Importance 1921	1920	Av. year	Range	loss
Tennessee	-	-	-	-	3
North Carolina	Common in southeast	Less	-	-	-
South Carolina	Moderate	More	Less	General	2
Georgia	-	-	-	-	2-5
Florida	Locally severe	-	-	-	-
Mississippi	Unimportant	Less	Less	General	3
Louisiana	Considerable	About same	About same	General	2-5
Texas	Prevalent	-	-	-	1
Arkansas	Fairly important	Less	Same	Mostly eastern half	1

Dates of first appearance of cotton anthracnose, 1921

July 8	Summerville, South Carolina
July 20	West Point, Mississippi
September	Scott, Arkansas

The following comments of collaborators are of interest: (See also Pl. Dis. Bul. 5: 104, 138. 1921).

Alabama: Next to wilt, most common cotton disease. (Povah).

Mississippi: The disease was not very important because of the dry season. (Neal).

Louisiana: Common in many localities and causing the usual loss. (Edgerton).

Arkansas: Fairly important; mostly in eastern half. Weather hot and fairly dry this season. (Elliott).

According to Colin G. Welles[1], anthracnose appeared in the Philippine Islands, where it had not previously been observed. The Colletotrichum stage was found on bolls of plants at the College of Agriculture, Los Banos. It is thought that strict quarantine of the College cotton, and careful seed selection will prevent the spread of the disease.

Literature cited

1. Welles, Colin G. Two serious plant diseases new to the Philippines. Philipp. Agr. 10: 253-254. Dec. 1921.

Wilt caused by Fusarium vasinfectum Atk.

Wilt was reported as general throughout the southern states, and seemed to have caused slightly greater damage than in the preceding year. The following table records the losses as reported by collaborators and the quotations below give additional data (see also Pl. Dis. Bul. 5: 103, 137. 1921).

Table 97. Relative prevalence of and losses from Fusarium wilt of cotton, according to collaborators, 1921.

State	Importance	Prevalence compared with: 1920	Av. year	Range	Percent loss
North Carolina	Most important disease	More	More	Coastal Plain and adjoining	10
South Carolina	Important	About same	About same	Southwestern	-
Mississippi	Important as usual	About same	About same	Rather general	5
Louisiana	Considerable	About same	About same	Sandy and upland sections	5
Texas	Prevalent	-	-	-	2
Arkansas	Always important	Less	Same	General	8

North Carolina: Coastal Plain section and several counties adjoining this section. Occurred in 60% of the fields, as much as 100% infection in some. Excessive transpiration and evaporation due to hot dry weather caused plants to succumb to disease. (Foster).

Alabama: Susceptible varieties show considerable loss. (Povah).

Mississippi: Important as usual; 20% of the fields infested, most in any field 15%. Caused most injury during June and July when plants were from one-third to one-half mature. (Neal).

Louisiana: Considerable in sandy and upland sections. (Edgerton).

Arkansas: Always important; somewhat less this year; 75% of fields infested with total infection in some. General; most severe in east and south and on sandy soils. Weather hot and fairly dry. (Elliott).

The following comments by collaborators are important in throwing light upon the present status of the wilt-resistant varieties:

North Carolina: Wilt was reported on practically all varieties with the exception of Dixie and Triumph strains. (Foster).

South Carolina: Much of the damage is done by compelling the cultivation of the resistant varieties which in the absence of wilt are less desirable than some others. (Ludwig).

Mississippi: Resistant varieties used in the hill section are Tricook, Lewis 63, and Governor Teal. Webber 49 and Express selections are semi-wilt resistant and largely planted in the Delta. (Neal).

Arkansas: Express is the most resistant of the commonly grown varieties. (Elliott).

For a discussion of the general situation in the southern states as to resistant varieties, the Farmers' Bulletin 1187 by W. W. Gilbert[2] should be consulted. Elliott[1] has found recently that cotton wilt is seed-borne.

Literature cited

1. Elliott, John A. Cotton wilt, a seed borne disease. (Abstract) Phytopath. 12: 50-51. Jan. 1922.
2. Gilbert, W. W. Cotton diseases and their control. U. S. Dept. Agr. Farmers' Bul. 1187. 1-32. Fig. 1-18. March 1921.

Angular leaf spot caused by *Bacterium malvacearum* EFS.

This disease was reported in general as less severe in 1921 than in the previous year, but is still considered a very important disease in many of the states.

North Carolina: A loss of 1% was caused by the angular leaf spot. (Foster).

South Carolina: Dry weather apparently checked the disease a great deal in many parts of the state. Faulwetter's method of control by seed treatment was retested during the season and found effective. (Ludwig).

Mississippi: About the same importance as last year, reducing the yield for the state about 2%. (Neal).

Louisiana: Very common, and in some localities has caused considerable shedding of the leaves. (Edgerton).

Texas: Very prevalent. Three percent loss. (Taubenhaus).

Oklahoma: Considering the whole loss to stand and to leaves in their relation to yield, I believe the loss to be over 5%. (Stratton).

Arkansas: Less prevalent than last year, reducing the yield 2%. Sulphuric acid delinting gave complete control. (Elliott).

For report on seed treatment see the article by Ludwig[1].

Literature cited

1. Ludwig, C. A. The control of angular leaf spot of cotton. (Abstract) Phytopath. 12: 50. Jan. 1922.

Root rot caused by Ozonium omnivorum Shear

Ozonium root rot was reported in 1921 to the Plant Disease Survey only from Texas, where it was very prevalent, causing a loss of 20%, according to Taubenhaus. This disease, which is commonly reported as most severe on all

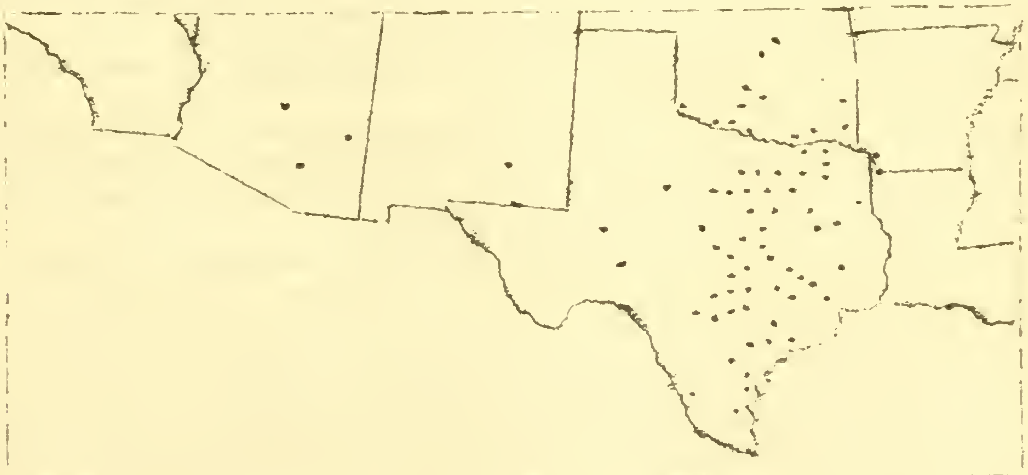

Fig. 83. Distribution of Ozonium omnivorum on cotton, according to records of the Plant Disease Survey, 1903-1921. Each dot represents a county from which the disease has been reported.

black, waxy limestone soils, is probably widespread in the southern tier of states west of the Mississippi on other soil types as well. Its distribution so far as the records of the Plant Disease Survey are concerned is given in the accompanying map (Fig. 83), with the hope that this charting will encourage close observation of present limits and of relations to soil types in order that fuller knowledge of the potentialities of the disease may be had.

Other diseases

Ascochyta blight caused by Ascochyta gossypii Sydow. This disease was reported in Supplement 16: 259. 1920, as due to Phoma sp., but determinations of Arkansas material made by W. B. Grove of Birmingham University, England, and comparison with authentic specimens of Ascochyta gossypii have shown that the causal organism is the latter fungus. In 1921 the disease began, in June, to cause considerable damage, but was checked by dry weather, so that it was much less important than in the preceding year, and caused only slight loss.

Elliott, J. A. A new Ascochyta disease of cotton. Arkansas Agr. Exp. Sta. Bul. 178: 1-18. Illus. April 1922.

Leaf spot caused by Cercospora gossypina Cke. was reported as doing slight damage in South Carolina and Texas.

Areolate cotton mildew caused by Ramularia areola Atk. was reported October 5 following heavy rains in Alabama. (Povah).

Rust caused by Aecidium gossypii E. & E. was reported as present in Hopkins County, Texas. (Taubenhaus).

Black rust attributed to Alternaria sp. was reported from Arkansas as completely defoliating cotton following angular leaf spot. (Elliott).

Boll rot, caused by various fungi, was reported from South Carolina and Arkansas as doing slight damage. Diplodia gossypina Cke. was definitely reported by Edgerton as causing about 2% damage in Louisiana.

Rhizoctonia rot, "sore shin", caused by Rhizoctonia sp. was reported as doing slight damage in Texas and Arizona.

Bacterial wilt caused by ~~Bacillus~~ + solanacearum EFS. was artifically induced on young cotton seedlings. (See Smith, E. F. and G. H. Godfrey. Bacterial wilt of castor bean (Ricinus communis L.). Jour. Agr. Res. 21: 255-261. 1921). Older plants were resistant, however.

Wilt of unknown cause was reported by Ludwig as present in Oconee County, South Carolina, first seen July 21 at Walhalla. The trouble is different from the ordinary wilt.

Root knot caused by the attacks of Heterodera radicicola (Greef) Müll. was reported from North Carolina (common, 1% damage - Foster), South Carolina (important - Ludwig), Mississippi (unimportant - Neal), Louisiana (slight loss - Edgerton), Arkansas (1% loss - Elliott), and Texas (1% loss - Taubenhaus).

Potash hunger was reported as occasional in North Carolina, and as rather more common than usual in South Carolina due to a tendency to slight use of fertilizers during the period of depression. In Louisiana, Mississippi, and Texas this form of trouble was not noticeable, but on poor soils in Arkansas it was reported as fairly important, reducing the yield for the state by 2%. (Elliott).

+ BACTERIUM

DISEASES OF SUGAR CANE

Mosaic (cause undetermined)

E. W. Brandes of the Office of Sugar Plant Investigations gives the following summary of the mosaic situation in 1921:

> "Sugar cane mosaic, according to authoritative information in the Office of Sugar Plant Investigations is present in Java, Egypt, Hawaii, Porto Rico, Santo Domingo, Virgin Islands, New Guinea, Philippines, Trinidad, Jamaica, Barbados, United States, China, Argentina, Cuba, in short in all the sugar producing districts of the world with the possible exception of India for which no authoritative reports exist. The distribution in the United States is restricted to Louisiana, Alabama, Georgia, Florida, and Mississippi. The distribution in Mississippi is based on reports of the Mississippi Plant Board which for the most part show the same counties as recorded last year. A report from L. E. Miles on August 15 shows the mosaic to be found at present on 111 properties of the 600 properties inspected. Inspections have been made in 45 counties and infections have been found in 16. At present mosaic infection is still known to occur in 12 counties; namely, Harrison, George, Greene, Jackson, Lamar, Lauderdale, Marion, Pearl River, Pike, Stone, Hancock, and Warren. The difference in records of 1921 and those of 1920 represents the eradication work being attempted. The distribution in Florida is the same as last year. The distribution in Alabama is restricted to Baldwin County."

The report by states is as follows:

Georgia: Sugar cane mosaic is known to occur in Brooks, Decatur, Grady, Mitchell, and Thomas Counties. (Brandes).

The effects of the extremely dry weather have masked the mosaic so as to prevent accurate estimates, but the crop is turning out 40 to 50% of normal. (Wright).

Mississippi: The attempt made by the State Plant Board to control the disease by roguing has resulted in failure because of the difficulties in the way of secondary infections. The only hope of control is in immune varieties. (Neal).

Louisiana: The distribution in Louisiana is the same as last year with the exception of reports of the disease from West Feliciana and St. Johns Parishes. The disease has spread so rapidly that it is present in practically all parts of the sugar belt. In the Bayou Teche district which is the last to become infected and which comprises the western portion of the sugar belt, the infection is yet mostly scattering, but in some places as high as 10%. We have no information on the loss caused by this disease though we are convinced that it is not so high as was predicted. There were some excellent yields from fields of nearly 100% infection. (Edgerton).

Porto Rico: Generally prevalent, injuring the crop in very variable proportions. Treatment consisting of elimination through seed selection and eradication has given excellent results. For all practical purposes there is little difference in the resistance of canes here. The Uba is the only immune cane we know. Growers are less concerned about it, because they know they can hold it in check and that its damage to cane is not as great as thought at first. (Matz).

New work by Brandes[1] on sugar cane mosaic in transferring the disease to related plants such as corn and numerous wild grasses is considered very significant in relation to control measures. Comparison also should be made with the reports on corn mosaic in the current Supplement on diseases of cereals, in which the work of Kunkel[2] on a possible causative agent of the mosaic disease of corn is discussed.

Literature cited

1. Brandes, E. W. Artificial and insect transmission of sugar-cane mosaic. Jour. Agr. Res. 19: 131-138. 1920.
2. Kunkel, L. O. A possible causative agent for the mosaic disease of corn. Bul. Exp. Sta. Hawaiian Sugar Plant. Assoc. 3 (1): July 9, 1921.
   And Kunkel, L. O. Ameboid bodies associated with Hippeastrum mosaic. Sci. n. s. 55: 73. Jan. 20, 1922.

Fiji disease (cause undetermined)

Interest in this disease has continued. Its known distribution has been increased by the discovery of its presence in another island of the Philippine group. The following letter from H. Atherton Lee, December 6, 1921, is worthy of note:

> "We have found Fiji disease distributed in the Island of Negros beyond the possibility of isolation. It has also been found in the Island of Mindanao although we believe that we have entirely eliminated it from that country for the time being. The spread of the disease would indicate that there is some aerial method of transmission of the disease for long distances."

The following references bring the scientific and trade comments on this disease to date:

Anonymous. Mindoro comments on Fiji disease. Sugar Cent. and Plant. News. 2: 127. April 1921.

Ashby, S. F. The Fiji disease of sugar cane. Agr. News. 20: 174-175. May 28, 1921.

Lyon, H. L. Three major cane diseases; mosaic, sereh, and Fiji disease. Bul. Exp. Sta. Hawaiian Sugar Plant. Assn. Bot. Series 3: 1-43. August 1921.

Medalla, M. G. Fiji disease of sugar cane in the Philippine Islands. Phytopath. 11: 251-252. Jan. 1921.

Medalla, M. G. and G. M. Reyes. Fiji disease of sugar cane. Philipp. Farmer 7: 3. Jan. 1921.
Reinking, Otto. Fiji disease of sugar cane. Sugar Centr. and Plant. News 2: 94-102. Mar. 1921.
____________ A Fiji disease of sugar cane. Sugar Centr. and Plant. News 2: 41. 1921.
____________ A Fiji disease of sugar cane in the Philippine Islands. Phytopath. 11: 334-337. pl. xv-xvi. Aug. 1921. (Dec.).

Gumming caused by Bacterium vascularum (Cobb) EFS.

Matz reports an increase of 300% in prevalence of this disease in Porto Rico, although the percentage of the crop injured was small. Good results have followed the use of resistant varieties along with eradication of diseased plants. Susceptible varieties are the Otaheite, B. 376, Calaucana, Crystalina, and Rayadà. The original area of infection has been extended from 15 kilometers to 50 kilometers at present. A strong campaign of eradication was waged last year and partial success was obtained, but it is difficult to get rid of the disease. There is one kind of cane grown mostly by small farmers, known as Otaheite = Bourbon = Lahaina = Native White, which possesses as much relation to gumming as the rat has to bubonic plague. Without this cane the disease can be eliminated by the use of healthy seed even from such slightly resistant canes as Crystalina and Rayada.

References

Ashby, S. F. Gumming disease of sugar cane in Java. Agr. News 20: 302-303. Sept. 17, 1921.
Matz, Julius. Observaciones en la gomosis de la caña en Puerto Rico. Rev. Agr. Puerto Rico v. 6, no. 4, p. 33-39. Illus. April 1921.

Root disease caused by Plasmodiophora vascularum Matz.

A report from Porto Rico by J. Matz indicates that this disease has greatly increased in prevalence. In this terriotry healthy seed and frequent cultivation are being used as means of combating the disease, it not being known yet whether there are any resistant kinds. The disease has been found very prevalent on the north coast as well as on the south coast. Matz states that:

> "It is the most serious disease of sugar cane here, it actually kills half grown canes producing a dry top rot. There are no striking symptoms, only stunting of cane and failure of crop. I cannot say that the disease is spreading, we simply learn more about its distribution. It has been here for years. It has been found in Barbados according to a communication from J. R. Bovel, Director of Agriculture of Barbados."

The following extract of a letter from Dr. Matz of January, 1922 discusses more fully the Barbados situation:

> "I wish to call your attention to the fact that Plasmodiophora vascularum has been found this year at Barbados. They received from here a mounted section of infected cane, on a slide, and have soon after discovered the presence of the organism in their canes. This indicates that the disease is present in other countries where sugar cane is grown."

References

Earle, F. S. Sugar cane root disease. Jour. Dept. Agr. Porto Rico. v. 4, no. 1. p. 1-27. Jan. 1920.
Matz, J. A new vascular organism in sugar cane. Jour. Dept. Agr. Porto Rico v. 4, no. 1, p. 41-46. Illus. Jan. 1920.

Downy mildew caused by Sclerospora sacchari Miyake

A Sclerospora disease on sugar cane and related grasses has been reported from the Philippines by Lee and Medalla[1] under the name of stripe disease, the organism concerned probably being Sclerospora sacchari. The disease was found in April, 1921 in a field of a Formosan variety in Rizal Province, Luzon, which had been introduced by a firm of Japanese growers in 1920. It was not found in fields of native cane nearby. Since S. philippinensis has not been inoculated into sugar cane, and has not been found in natural infections in fields of sugar cane near badly infected maize, the evidence is strongly suggestive of the introduction of the sugar cane downy mildew, S. sacchari, from Formosa. The infected fields were plowed up, the stubble burned, and the land fallowed, and steps were also taken to trace any seed cane emanating from the affected fields. It is thought possible that the disease may be entirely eradicated in the Islands.

For a discussion of the present situation of sugar cane downy mildew in the Philippines, see the article by W. H. Weston[2]. Reference should also be made to the report of Weston[3] in the Journal of Agricultural Research.

> "Sclerospora spontanea, the more recently discovered form, occurs in the Islands of Cebu, Bohol, and Leyte, where it was found on the wild grass (Saccharum spontaneum L.), on sugar cane (Saccharum officiarum L.), and on maize (Zea mays L.). Sclerospora philippinensis, the species first recognized, occurs in the Island of Luzon, where it was found on maize, teosinte (Euchlaena luzurians Schrad.), and sorghum (Andropogon sorghum (L.) Brot.)."

Literature cited

1. Lee, H. A. and M. G. Medalla. Leaf stripe disease of sugar cane in the Philippines. Sci. 54: 274-275. Sept. 23, 1921.
2. Weston, W. H. A note relative to the recent appearance of the sugar cane downy mildew in the Philippines. Phytopath. 11: 371-375. 1921.
3. Weston, W. H. Another conidial Sclerospora of Philippine maize. Jour. Agr. Res. 20: 669-684. Febr. 1, 1921.

New and little known diseases

Philippines: H. Atherton Lee reports several sugar cane diseases of considerable importance:

Sclerotial banded disease reported by Butler in India is very common throughout the Philippines, especially on native varieties. First report.

Leaf spot caused by Pestalozzia fuscescens Sorauer var. sacchari was found on native varieties in Jolo and Sulu. First report.

Red vascular disease on H 109 cane in Negros, occurring sporadically, similar to a trouble shown by H. L. Lyon at Olaa in Hawaii. It is different from Sereh according to Lyon. In the Philippines there are considerable possibilities of this disease causing damage.

Ring spot caused by Leptosphaeria sacchari Breda de H. is common on Negros Purple cane. First report.

Root disease caused by Aeginetia indica (flowering plant). Very serious in Laguna and Batangas Provinces. The disease is not apparent until the cane is full grown and does not visibly harm the cane or cause it to appear abnormal, however, the sugar content is reduced to a very small proportion of that of normal cane. This disease should certainly not be allowed to enter into Hawaiian plantations or any other country in the western hemisphere.

Other countries:

Striga root parasite. cases of parasitism by a flowering plant (Striga densiflora Benth.) and Striga euphrasioides Benth.) on sugar cane and sorghum are described by Luthra, J. C. Striga as a root parasite of sugar cane. Agr. Jour. India 16: 519-523. 1921.

Schizophyllum commune Fr. is reported as a parasite on sugar cane by Vincens, Francois. Parasitisme du Schizophyllum commune Fries sur la canne a sucre. Bul. Agr. Inst. Sci. Saigon 3: 65-68. 1921.

Frog hopper blight is reported from Trinidad by C. B. Williams. In this disease the attack by frog hopper is most important, although the loss is aggravated by root disease (Marasmius). (Williams, C. B. Report on the frog hopper blight of sugar cane in Trinidad. Mem. Dept. Agr. Trinidad & Tobago 1: 170. 1921.

Sereh disease of sugar cane is discussed fully by H. L. Lyon and is compared with mosaic and Fiji diseases. (Lyon H. L. Three major cane diseases; mosaic, sereh, and Fiji disease. Bul. Exp. Sta. Hawaiian Sugar Plant. Assn. Bot. Series 3: 1-43. August 1921). In this report it is brought out that its reported occurrence in Hawaii in 1920 by Walter Maxwell was erroneous, the disease in question was probably mosaic but possibly Fiji disease.

Other diseases

Red rot, caused by Colletotrichum falcatum Went. was reported as very severe in Florida, the severity being traceable to seed of low quality coming from areas where red rot is prevalent. The first reports were received

February 10 from Bradentown. "During the recent County Agent meeting all agreed that red rot is the worst disease of sugar cane in this state." (Burger). Neal of Mississippi, reports a damage of 5% in a twelve acre field in Pearl River County. Edgerton, in Louisiana, reports moderate amount of the disease which does its damage by reducing the sucrose content. H. A. Lee states that the red rot fungus has been found in Pampanga Province, Philippines, causing leaf injury but never causing red rot of the cane.

Recent literature

Edgerton, C. W. and C. C. Moreland. Fungi and cane germination. Sugar 23: 16-17. Jan. 1921.

Venkatarayan, S. V. Red rot of sugar cane. Mysore Agr. Calendar 1921.

Root rot caused by Marasmius plicatus Wak. and other fungi. Considerable loss from this cause all over the sugar belt in Louisiana was reported by Edgerton. (See also Edgerton, C. W. and C. C. Moreland. Fungi and cane germination. Sugar 23: 16-17. Jan. 1921).

Root rot, caused by Pythium butleri Subramaniam, is reported by Carpenter[1].

> "1. The Pythium-like fungus previously reported[2] as an active factor in the root rot disease of cane (Lahaina disease) is morphologically identical with Rheosporangium aphanodermatus Edson and Pythium butleri Subramaniam.
>
> "4. The writer considers that the cane fungus manifests a type of diplanetism in the asexual stage allied to that in the conidium-producing Pythium, and prefers to classify it in the genus Pythium rather than in Edson's new genus Rheosporangium."

Literature cited

1. Carpenter, C. W. Morphological studies of the Pythium-like fungi associated with root rot in Hawaii. Hawaiian Sug. Plant. Assn. Exp. Sta. Bul. 3: 59-65. Aug. 1921.
2. ________________ Preliminary report on root rot in Hawaii. Hawaiian Agr. Exp. Sta. Press Bul. 54.

________________ Pythium in relation to Lahaina disease and pineapple wilt. Hawaiian Plant. Record 23: 142-174. 1920.

Root rot caused by Rhizoctonia grisea, is reported from Porto Rico by Matz. (Matz, J. Investigations of root disease of sugar cane. Jour. Dept. Agr. Porto Rico. 4^1: 28-40. Jan. 1920).

Iliau caused by Gnomonia iliau Lyon was reported by Edgerton as of slight importance in Louisiana this year. It causes a stunting and death of the stalks.

Poor germination of "seed". "A great many different fungi are found on seed cane but the more abundant or more serious ones are Colletotrichum falcatum Went., Melanconium sacchari Massee, Gnomonia iliau Lyon, Marasmius plicatus Wak., Thielaviopsis paradoxa (De Seyn) von Höhn, and species of Fusarium and Scopularia." (Edgerton, C. W. and C. C. Moreland. Fungi and cane germination. Sugar 23: 16-17. Jan. 1921).

Leaf sheath disease caused by Sclerotium rolfsii Sacc. was reported as common in Porto Rico, causing decay of leaf sheaths and adjacent portions of cane stalk of Crystalina cane. (Matz).

DISEASES OF SUGAR BEET

Leaf blight caused by Cercospora beticola Sacc.

Leaf blight was in 1920 of slight importance in the majority of beet growing districts of the United States. In 1921 with higher temperatures, earlier season, bright days, and fairly well distributed rainfall at the end of the season, this disease caused grave loss in many of the beet growing sections, especially Michigan and the Arkansas Valley in Colorado. In Michigan the disease is commonly of but slight importance, but in 1921 it reduced tonnage and sugar content below the point of profitable manufacture, according to statements made by agriculturists of the factories, who place the loss at between two and three millions of dollars. (Coons). In the Arkansas Valley of Colorado 80% of the fields were affected and some fields showed between 95 and 100% infection. "This disease is very prevalent in one of the large sugar beet sections. It has caused a heavy loss in this section this year, and the growers are very much concerned about control measures. It has been prevalent for several years, but this year there has been the greatest loss." (Learn). Ohio, Wisconsin, Iowa, and South Dakota report slight losses. Indiana reports the disease as much worse and probably reducing the yield for the state by 1%. (Gardner). The Utah situation presents some interesting features. The disease is known from the Utah and Cache Valleys and was seen on an area about 200 acres in extent, but doing slight damage, however. (Pack).

Curly top (cause undetermined)

Curly top was reported from Utah, Idaho, and Washington, but probably existed throughout its general known range of western states, which coincides with the known range of the sugar beet leaf-hopper, Eutetix tenella.

The following reports of disease losses are important:

Utah: Less prevalent than last year, found in 10% of the fields, affecting on an average 1% of the plants and reducing the yield 1%. Known from the Sevier, Sampete, Utah, Salt Lake, and Cache Valleys. First seen in June in Centerfield, but doing its greatest damage in early and mid-summer. (Pack).

See also comment on effect on seed production in Plant Disease Bulletin 5: 139. November 1, 1921.

Idaho: Very important, common in sugar beet sections. "It has become clearly evident this year in several cases that stecklings infected with curly top will not produce any amount of seed. Total loss of seed selections have resulted in some cases." (Hungerford).

More prevalent than last year causing a total loss on 2,697 acres and a 25% loss on 16,783 acres, reducing the yield for the state 12.5%. The geographical distribution is in the Lower Snake River Valley, especially around Twin Falls, Burley, and Minidoka. First seen in May at Filer. (Pack).

Washington: Crop loss on sugar beets estimated at 3%. (Heald and Dana).

California Some promising types of sugar beets resistant to curly top are being grown at isolated places throughout Riverside County.

Comparison of known distribution of the curly top leaf-hopper and curly top, as shown by E. D. Ball in Utah Station Bulletin 155, makes it very evident that distributional studies of both insect and the disease should be vigorously pushed, along with intensive study of factors governing regional distribution, in order that adequate protection may be given other beet areas. Dr. Ball also calls attention to the possibility of cycles of the insect and waves of disease. "I would like to call your attention to page 34 (Loc. cit.) for a time distribution of attacks which very strongly suggests that the four-year troubles that they have been having in California and the western country generally are another cycle of increase which will be rapidly followed by a decrease."

"From all information that I have, there has been no extension of distribution recorded except that the leaf-hopper has been seen in one place on the alkali plants on the shores of western Florida, probably a drift from Texas. (E. D. Ball).

Root rots

Root rot caused by Phoma betae (Oud.) Frank. This disease was reported as producing either no loss or very slight loss in Indiana, Wisconsin, Colorado, and Washington. In several other states loss was important.

Utah: More severe than last year, causing a reduction in yield to the state of 8%. Blighting of the top (leaves) and finally a root rot occurs. Was present throughout the state, but especially severe in Cache and Box Elder Counties. First recorded July 8 at Logan. The estimate of loss is not based upon definite data gathered from the entire state, but from studies made primarily in Cache and Box Elder Counties. Allowances were made for the small amount of disease in other beet growing districts. Twenty percent loss probably occurred in Cache County. (Richards). (See also Plant Disease Bulletin 5: 140, Nov. 1, 1921).

Idaho: More prevalent than last year, being important in southeastern Idaho around Bear Lake, Minidoka, Twin Falls, and Madison Counties. (Raeder).

Michigan: Root rot and leaf spot are becoming more manifest in this territory each year, the percent of loss depending on the weather conditions. The crop in this immediate territory this past year yielded only six tons to the acre as compared with a ten-year average of ten tons per acre. Of this 40% loss in tonnage, I attribute 25% to root rot. I base this on counts of thousands of plants that I made in representative commercial fields. This direct tonnage loss was increased 15% by leaf spot which defoliated many of the plants which resisted many of the attacks of root rot.

The fact that the average sugar content of all the beets in this territory has also been greatly reduced is, in my judgment, largely due to both the above diseases. The average sugar content of the cossettes of the Blissfield Plant is 13%, as compared to 15% for a ten-year average.

I am unable to determine the percentage of this sugar content loss which is attributed to each of the diseases under discussion. Both the diseases retard the normal functioning of the plant. The leaf spot, by defoliating the plants, retards the storage of sugar and depletes the amount previously stored in growing new leaves. Root rot entirely destroys a large percentage of the beets and many of the plants that do survive the disease have malformed roots incapable of the storage of a normal amount of sugar. Another factor of loss in root rot is the fact that in many cases the entire planting is lost, requiring replanting, even the second and third planting resulting in the entire loss of the crop or a diminished stand. The diminished stand, the extra amount of seed required for replanting, the additional cost of labor in refitting the ground, the diminished yield caused by the late planting occasioned by the loss of the previous planting, are all factors of loss. (Letter to Dr. C. O. Townsend, Sugar Plant Investigations, from W. H. Burns, Agriculturist, Sugar Plant Investigations, Blissfield, Michigan, January 17, 1922).

Rhizoctonia rot (other organisms may be associated) caused considerable loss in Indiana (Gardner), 10-25% loss in some Michigan fields (Coons), sometimes common and destructive in Iowa (Melhus), rather serious in Cache County, Utah, but less than in 1920, producing dry rot canker; known for Cache, Davis, and Webber Counties, but first seen July 15 at Cornish. (Richards), slight damage also reported by D. A. Pack from the Bear River Valley, Utah.

Root rot (undetermined). Root rot taking the form of damping-off or a rotting of the main root with half grown beets was reported as very serious in Indiana, Michigan, Wisconsin, Utah, and Idaho. Heavy rains at time of thinning operation and before seem associated in Indiana where the loss for the state is estimated at 5%. First seen June 1 in Allen County. Fort Wayne records show that it rained May 23, 24, 25, 26, 27, 28, 31, June 2, and 3. (Gardner).

Michigan: Poor stand common in many sections where beets semingly outgrew primary damping-off. Flagging occurred in July and August due to blackened tap root and inability to stand drouth conditions. Trouble was seen to be much worse where beets followed beets or clover and of minor importance where beets followed corn. (Coons).

Wisconsin: Stand of beets only fair. (Bureau of Crop Estimates Crop Notes, week ending June 25).

Utah: Root rot of unknown cause was much more severe than last year. Twenty-six percent of the Cache Valley acreage was infested, causing a loss of approximately 86,000 tons of beets and a reduction in yield for the state of over 6%. The spring was wet (2.8 inches above normal) with summer and fall temperatures down. (Pack).

Idaho: Much more severe, reducing the yield in the state 12%. First seen in August at Sugar City. Spring moisture was .38 of an inch above normal; summer and fall were dry. Both spring, summer and fall were much higher than normal. (Pack). (See also Plant Disease Bulletin 5: 139. November 1, 1921).

Alternaria root rot was reported as extremely prevalent in the Arkansas Valley and in Utah, attacking in August, but doing its greatest damage in September. (J. G. Lill and D. A. Pack).

Other diseases

Rust caused by Uromyces betae (Pers.) Tul. was reported from California by Milbrath as doing slight injury.

A disease which reduced the leaf surface, stunted the roots, and caused premature death everywhere in Indiana was first seen August 5 at Decatur. This appears to be the same trouble described by Cunningham in 1899 in the Botanical Gazette as a bacterial disease. Specimens sent to Carsner and the trouble was pronounced not to be curly top. (Gardner).

Root knot caused by Heterodera radicicola (Greef) Müll. was reported by Milbrath of California as follows: "Throughout the state the loss can be estimated at 8% as an average. The range of loss extended from a trace to 75%, in individual fields." Gerald Thorne of Utah reports as follows: "Quite general in Davis County where 125 fields were infested. The total number in the state was probably not less than 200. Injury ranges from very slight to 50% of the crop in some small fields. Known for Salt Lake, Cache, Utah, Box Elder, Webber, and Davis Counties."

Nematode injury caused by Heterodera schachtii Schmidt has infested many of the principal beet growing sections of Europe causing severe losses. First found in western United States about 15 years ago. Since that time found in many of the principal beet growing sections of Utah, Idaho, California, and Colorado. As a result of survey of the Office of Sugar Plant Investigations, it is found that infestation is spreading rapidly and is becoming a serious menace to the sugar beet industry in some localities. (See Fig. 84). At present only about one-twentieth of the sugar beet acreage in the United States has been inspected and it is probable that many additional fields will be found when careful inspection is made. The following summary of sugar beet acreage surveyed gives the present status:

Table 98. Present status of the sugar beet acreage surveyed.

State	Total acresge surveyed	Acreage infested
Utah	24,473	3,238
Idaho	2,096	515
Colorado	7,160	899
California	18,945	2,535
Total	52,674	7,187

In figuring the infested acreage, the total areas of infested fields are given. Since the actual infested areas vary from a few square rods to the entire field, it will be conservative to figure the actual affected area as 25% or 1,795 acres. The average loss because of the infestation will be not less than six tons of beets per acre or 10, 662 tons. Valued at $12.00 a ton, the cash loss to the growers alone was $129,000. This was the loss in only the areas surveyed and it is very doubtful if more than two-thirds of the infested areas are included in these surveys. Many areas are known to be infested in which no work has yet been done. (Gerald Thorne and L. A. Giddings).

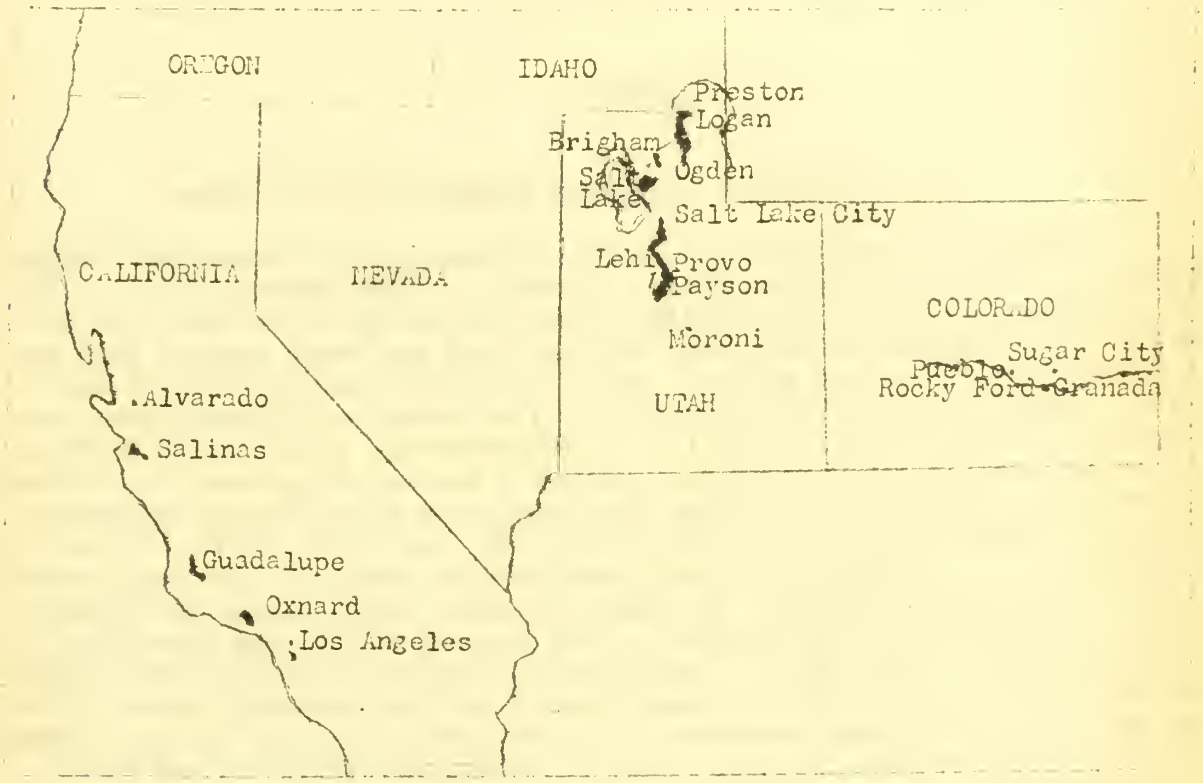

Fig. 84. Distribution of the sugar beet nematode in western United States. (After map by Thorne, Gerald and L. A. Giddings, Farmers' Bulletin 1248: 4. Feb. 1922).

Utah: Found in Cache, Box Elder, Webber, Davis, Salt Lake, Utah, and Sampete Counties. Actual infested acreage is placed at 600, of which about three-fourths has been surveyed, the remainder estimated. The area of fields infested in the state, part of which are under crop rotation is 4,395 with an actual infestation area in the state at approximately 1,100 acres. (Gerald Thorne).

Colorado: Found in the Arkansas Valley, Pueblo, and Rocky Ford. In the Pueblo district 20% of the fields are infested. There are scattering fields in other districts. The disease is known in 470 acres, reducing the yield on an average 3,820 tons. (Charles Price).

California: Infested areas are on the increase. About 7% loss can be estimated for the state, ranging per field from a trace to 20%. (Milbrath).

The following German summary of control measures may be cited: Müller, H. C. and E. Molz. Versuche zur Ermittlung des Wirkungswertes verschiedener Stoffe zur Bekämpfung der Rübennematoden in Schlammerdam. Blätt. Zuckerrübenb. 28: 96-102, 144-149. May, July 1921. no. 9/10, 13/14.

Nematode - Tylenchus penetrans Cobb was found in a small area near Ogden, Utah; damage slight. (Gerald Thorne).

TOBACCO

Wildfire caused by Bacterium tabacum Wolf and Foster

Wildfire was reported by Lutman as serious in the Connecticut Valley, Vermont. It was more prevalent than formerly in Massachusetts where it did slight damage, being spread rapidly by hard rains. (C. M. Slagg). In Connecticut the disease was also more prevalent and may cause serious loss due to depreciation of market values. The disease was found in Hartford and Toland Counties, first appearing in May. (See notes by Clinton, Plant Disease Bulletin 5: 19, July 1, 1921). In Pennsylvania, according to Thurston and Orton, the disease was serious, causing a loss of 10%, being first found in Lancaster County, May 28, 1921. (For data as to distribution in Pennsylvania, see Plant Disease Survey Bulletin 5: 37, and 5: 88, 1921). It was reported by J. E. McMurtrey as doing considerable damage in Maryland (Prince Georges and Calvert Counties); by Fromme as doing slight damage in Virginia (.5%). Valleau reports the disease as not serious in Kentucky (See Plant Disease Bulletin 5: 19, 1921). Sherbakoff in Tennessee reports that tobacco was affected with wildfire, but less than during the preceding season. "We are now recommending seed treatment with formaldehyde 1 to 16 for 15 minutes with subsequent washing, without which the treatment with us is not safe." Other states reported as follows: North Carolina, slight; South Carolina, important locally; Ohio, definite report of occurrence made by Clayton; Wisconsin, no wildfire occurs in commercial fields. (James Johnson).

Union of South Africa: The following report appears in the Journal of the Department of Agriculture of South Africa 2: 310, April 1921. "The bacterial disease of tobacco previously recorded ..... is spreading rapidly. So far as investigation has gone, it bears a very strong resemblance to the wildfire of tobacco reported from the United States."

Studies by Slagg (Slagg, C. M. Preliminary report on a study of the wildfire disease of tobacco. (Abstract) Phytopath. 12: 51-52. Jan. 1922) indicate that there is some variation among the organisms responsible for this condition.

Angular spot caused by Bacterium angulatum Fromme and Murray

This disease was known previously from Virginia, Kentucky, and Tennessee, and its presence was suspected in Ohio. In 1921 it was reported as not being seen in Massachusetts, Connecticut, and Pennsylvania, and undistinguished in Maryland. Positive reports from North Carolina and Indiana where it was reported as being serious locally extend the range for the United States. The following statement by H. W. Taylor of the Board of Agriculture of Rhodesia, South Africa is of interest:

> "Wildfire and angular spot occur in Rhodesia and were no doubt introduced from the use of tobacco seed imported from the United States. The angular spot has been very prevalent during the past two seasons and has caused severe loss to many tobacco growers. The Department of Agriculture is prepared this year to treat tobacco seed free for farmers in southern Rhodesia."

Kentucky: Widespread, but not causing so serious a loss as in 1920, on account of the dry season. In a few places there has been considerable infection following heavy rains with wind. (Valleau).

Virginia: Loss, slight to moderate this year, reducing the yield of the state 5%. Infection was general, but held in check by dry weather. Seed treatment coupled with proper plant bed sanitation gave excellent results. (Fromme). (See Fromme, F. D. and S. A. Wingard. Treatment of tobacco and suggested program for control of wildfire and angular spot. (Abstract) Phytopath. 11: 48-49. 1920).

Root rot caused by Thielavia basicola (B. & Br.) Zopf.

This root rot was generally reported as prevalent in tobacco sections, but all collaborators agree that the disease was much less severe than in 1920. The following estimates of loss were reported: Massachusetts 3%, Connecticut 5%, Pennsylvania 5%, and Wisconsin 1%.

Varieties vary in resistance

Cuban (shade) is more resistant in Massachusetts than Havana (air grown) seed, according to Slagg. Clinton reported that Round Tip is rather exempt in Connecticut. The Connecticut varieties stand as follows in resistance: first, Connecticut Round Tip; second, Shade Cuban; third, Broadleaf; and fourth, Havana. Tests of five resistant strains are being carried on in Kentucky. Selby reports marked resistance of the new Montgomery Seedling variety in Ohio where one or two Spanish sorts were also resistant, while a test of the root rot resistant strain received from Wisconsin showed serious infection. James Johnson states that in Wisconsin marked differences in resistance of strains are evident and that resistant strains are being used commercially on about 3,000 acres in that state.

Mosaic (cause unknown)

Mosaic was reported from Massachusetts, Connecticut, Pennsylvania, Maryland, Virginia, Kentucky, North Carolina, South Carolina, Ohio, Wisconsin, and Hawaii. No state reported more than 2% damage. For comments by collaborators, see Plant Disease Bulletin 5: 106-107. 1921.

Experimental work by Johnson (Johnson, James. Experimental evidence relating to the nature of the mosaic virus. (Abstract) Phytopath. 12: 52. Jan. 1922) has shown that the optimum temperature for mosaic disease of tobacco lies close to 28-30°C. with a maximum of approximately 37°C.

Downy mildew caused by Peronospora hyoscyami de Bary

In 1921 downy mildew (also called "blue mold") of tobacco appeared in the United States for the first time. According to Smith and McKenny[1] of the Federal Department of Agriculture, it was first observed about March 21 in seed beds in Gadsden County, Florida, and during the rest of March and the first part of April it spread rapidly throughout Gadsden County and the adjoining Decatur County, Georgia. It aroused great apprehension among the growers, who believed they were threatened with the complete loss of their crop; but the hot dry weather which prevailed after the middle of April and during May, checked its progress so that the total loss in the affected district probably did not exceed 5%.[2]

According to O. F. Burger, the disease was confined to the sand leaves and was favored by the cool weather of April, but later checked by warm dry weather.

The following publications have appeared recently on this disease:

1. Smith, E. F. and R. E. B. McKenney. A dangerous tobacco disease appears in the United States. U. S. Dept. Agr. Cir. 174. April 1921.
2. ______________________________ The present status of the tobacco blue mold (Peronospora) disease in the Georgia-Florida district. U. S. Dept. Agr. Cir. 181: 3-4. 1921.

Burger, O. F. and H. C. Parkham. Peronospora disease of tobacco. Florida State Plant Bd. Quart. Bul. 5: 163-167. July 1921.

Palm, B. T. The false mildew of tobacco introduced into the United States from the Dutch East Indies. Phytopath 11: 430-432. 1921.

Smith, E. F. and R. E. B. McKenney. Suggestions to growers for treatment of tobacco blue mold disease in the Georgia-Florida district. U. S. Dept. Agr. Cir. 176: 2-4. 1921.

Wilt caused by Bacterium solanacearum EFS.

Virginia: More prevalent than in 1920, being reported from Patrick, Pittsylvania, Charlotte, and Mecklenburg Counties, reducing the yield for the state .5%. Its unusual prevalence probably associated with hot, dry season. (Fromme).

North Carolina: Most destructive of the tobacco diseases, land often being abandoned because of its infestation with the wilt organism. Common this year on land grown to tobacco for years, especially in Granville, Vance, Durham, and Wake Counties. (Foster).

Other diseases

Leaf spot caused by Cercospora sp. was reported by H. Atherton Lee as doing slight injury in the Philippines. There are localities in the northern province of Luzon where leaves affected with Cercospora bring a higher price than normal leaves. This is due to a confusion of these leaf spots with what is known as "batec". This batec seems to be due to some sunburn injury or possibly some varietal characteristics. Such batec leaves are said to have a better flavor.

Kunkel reports that a leaf spot, probably caused by Cercospora was found at South Koua, Hawaii.

Damping-off caused by various fungi. Damping-off by Rhizoctonia and by Sclerotinia libertiana were reported from Connecticut. Pythium debaryanum caused damping-off in Pennsylvania and Connecticut. Wisconsin reports damping-off as widespread but of slight importance.

Wilt caused by Fusarium oxysporum nicotianae Johnson. Found first near Benedict, Charles County, Maryland in 1916 and in 1917 on other farms, while in 1919 it was received from Owensville, Ohio on mature plants of White Burley. It is believed that Fusarium wilt is not a serious disease, and will probably never become of great economic importance; if, however, it becomes more generally introduced into the White Burley districts it may become a serious parasite. (Johnson, James. Fusarium wilt of tobacco. Jour. Agr. Res. 20: 527-535. 1921).

Streak. A disease resembling streak of potato was noted by Kunkel at South Koua, Hawaii.

Hollow stalk (bacterial) was reported from Massachusetts and Connecticut as of minor importance.

"Black rot". Some black rot occurred during the fermentation of the 1920 crop, one warehouse reporting a very considerable loss running into several thousand dollars. (J. Johnson).

Fusarium leaf spot was reported as producing inconspicuous injury on weak plants in the seedbed and occasionally found on shade leaves in the field. (Clinton).

Injury to tobacco from fertilizer was reported from Connecticut and North Carolina.

Drouth spotting was reported from Connecticut and Ohio.

White speck was important on the Broadleaf variety in Connecticut.

Potash hunger, showing itself by the production of yellow spots on the leaves and by dwarfing, was reported from Virginia.

"Rust" was reported as doing slight damage from practically all the tobacco sections. This is the general term, having no specific meaning, but in 1921 the most prevalent type was the dying after severe mosaic attacks. This was reported from Wisconsin and Connecticut.

Non-parasitic spots of different types were reported from Massachusetts, Connecticut, and Wisconsin. A discussion of this type of breakdown was given by Johnson at the Toronto meeting. (Johnson, James. Non-parasitic leaf spots of tobacco. (Abstract) Phytopath. 12: 52. Jan. 1922).

DISEASES OF MISCELLANEOUS VEGETABLE CROPS

ARTICHOKE

Southern blight of Jerusalem artichokes, Sclerotium rolfsii Sacc. - South Carolina, unimportant.

Wilt, Sclerotinia spp. - Washington.

ASPARAGUS

Rust caused by Puccinia asparagi DC. was reported from Vermont, New York, Pennsylvania, Texas, Iowa, North Dakota, Colorado, and Washington as present and doing slight damage, and from Michigan and Minnesota as more prevalent than during the previous years. The result of a questionnaire concerning the prevalence of rust and the use of resistant varieties has been summarized in the Plant Disease Bulletin 5: 120-121, which should be consulted by those interested.

It is evident from the tone of the replies to the questionnaire that in the majority of the localities the asparagus rust situation is of minor importance and that in those areas where the culture is intensive the use of resistant or semi-resistant varieties is giving good satisfaction. It is extremely important that further attention be given this crop and that observations on the various strains, especially the Washington varieties, should be continued. The seed of these varieties was originally distributed by the Office of Cotton, Truck, and Forage Crop Disease Investigations to experiment stations, seedsmen, and individuals in the various states, and sources of seed and roots should be located in order that the promising advance made by the development of these varieties be not lost.

Root rot caused by Fusarium spp. Dying out of roots over circular areas, a disease in which the plants were stunted, became brown, and finally died, was reported by Cook at the Toronto meeting. (Cook, Mel T. A new disease of asparagus. (Abstract) Phytopath. 12: 49. 1922) as a "new" disease. He stated, however, that since his observation was made it has come to his attention that Halstead had previously described this disease. In the questionnaire on asparagus rust several collaborators (Massachusetts, New York, Illinois) included a report that a root and crown rot due to Fusarium had been noticed and was causing greater loss than rust. The disease is evidently widespread and of considerable importance. What may be the same type of trouble in California is referred to by Milbrath: "At Sacramento I found considerable 'rusty' lesions on asparagus shoots, sometimes attributed to Fusarium sp."

Rhizoctonia rot following frost injury was reported from Michigan.

BEET (Garden)

Scab caused by Actinomyces scabies (Thax.) Güssow was unimportant in New York, New Jersey, Ohio, and Idaho.

Leaf spot caused by Cercospora beticola Sacc. was of slight importance in New Jersey, Ohio, Minnesota, and North Dakota; in Texas, very prevalent, 5% loss; in Indiana very serious factor in market gardens, causing a loss of 1%; and in Illinois the most important beet disease.

Root knot caused by Heterodera radicicola (Greef) Müll. caused 1% loss in Texas.

Damping-off caused by Pythium debaryanum Hesse caused slight injury in seedbeds at Westville, Connecticut.

CARROT

Watery soft rot caused by Sclerotinia libertiana Fckl. was reported by food-products inspectors of the Bureau of Markets and Crop Estimates as occurring in carloads of carrots originating in Louisiana, Mississippi, New York, South Carolina, and Texas.

Rhizopus rot caused by Rhizopus sp. was reported by market inspectors as causing slight decay in carloads of carrots from Indiana, New York, South Carolina, and Texas.

Leaf spot caused by Cercospora apii carotae Pass. was reported from Pennsylvania, and from Indiana as worse than last year in market gardens, being very destructive to foliage, especially under overhead irrigation. It was first reported July 12 from Marion County. (See also Murata, Jutaro. Leaf blight of carrot and its control. I. Jour. Plant Prot. 8: 185-188. April 1921 (Japanese), and Leaf blight of carrot and its control. II. Jour. Plant Prot. 8: 233-236. May 1921).

Decay caused by Alternaria sp. (See Meier, Fred, Chas. Drechsler, and Emery Eddy. Storage rot of carrots caused by a new species of Alternaria. (Abstract) Phytopath. 12: 49. 1922).

Root knot caused by Heterodera radicicola (Greef) Müll. was reported from Ohio and Washington.

Rhizoctonia rot caused by Rhizoctonia crocorum DC. Western Washington: The violet Rhizoctonia is also found commonly on the common carrot in affected districts where it also is common on potatoes. (Frank).

CASTOR BEAN

Bacterial wilt caused by Bacterium solanacearum EFS, according to Smith and Godfrey, was found on castor beans at several points in Florida, one place in Georgia, and one in Alabama; and from reports of farmers it very likely occurs in North and South Carolina and Mississippi also. The disease was not found on the east coast of Florida, although thorough search was made. The soil on the east coast contains an abundance of lime. Newer land is more likely to show the wilt than land that has been under cultivation longer. Losses up to 10%, exceptionally over 10%, occur. The highest loss observed was 30% in a field in Georgia. (Smith, Erwin F. and G. H. Godfrey. Bacterial wilt of castor bean (Ricinus communis L.). Jour. Agr. Res. 21: 255-261. May 16, 1921).

Texas root rot caused by Ozonium omnivorum Shear was very prevalent in Texas, causing a reduction in yield of 25%.

CELERY

Yellows caused by Fusarium sp.

This disease is to the celery crop what cabbage yellows is to cabbage. It was first studied in Michigan, but evidently very widespread in the northeastern celery growing districts, being reported by Coons and Nelson[1] as known from New Jersey, Indiana, Massachusetts, and Connecticut. Reports to the Plant Disease Survey for the 1921 season show the disease to be present in Indiana, Michigan, Minnesota, and Colorado (specimens from each locality examined by Nelson and Coons). The report from Indiana states that the disease was less serious than in the previous year but was a limiting factor with the Golden Self-blanching variety. Gardner reports that growers at Goshen, Indiana have substituted Easy Blanching and that no yellows could be found September 22, although in that same district 100% soil infestation has been present since 1914. The Michigan report states that there was a complete loss of Golden Self-blanching, and even of Easy Blanching, in some soils due to the very high soil temperature. "This is a soil sickness and rapidly becomes a 100% infestation. Loss is lessened by use of the green variety 'Easy Blanching'. Annual loss from failure of Golden Self-blanching and from the use of a variety of less market value can conservatively be placed at $2,000,000." (Coons and Nelson). Minnesota reports the first occurrence of this disease in Ramsey County where it caused a severe stunting of a large percentage of plants. Learn of Colorado reports an unknown yellowing of plants as quite common about Denver, which in view of specimens received from the same locality and diagnosed by Coons may fairly safely be attributed to Fusarium.

Report of progress in developing yellows-resistant seed of Golden Self-blanching celery is made by Coons and Nelson[2]. A report of the Minnesota occurrence of the disease is made by R. C. Rose[3]. (See also Plant Disease Bulletin 5: 148-151. 1921).

References cited

1. Coons, G. H. and Ray Nelson. Celery yellows. (Abstract) Phytopath. 11: 54-55. 1921.
2. ______________________________ First progress report on "yellows" resistant Golden Self-blanching celery. (Abstract) Phytopath. 12: 48. 1922.
3. Rose, R. C. Two destructive plant diseases. Minn. Hort. 49: 333-334. Dec. 1921.

Late blight caused by Septoria apii (Br. & Cav.) Chester

Celery late blight was reported from Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Ohio, Michigan, North Dakota, Washington, and California. In general, in those states raising early crop celery, blight was severe where July and August rains were frequent. New Jersey reports the disease as abundant and causing heavy loss. Delaware reports a reduction in yield of 5%. The greatest loss was reported from Michigan where a loss of 25 to 50% of the late crop was brought about by the heavy and well distributed September rainfall. The report from California stated that in the 1920-21 crop in the El Monte district there was a loss of 15% and in the Watsonville district one of 20%. Milbrath comments further that the disease was unusually severe in these sections due to cessation of spraying on account of market conditions. In the San Diego district there was considerable infection which was kept under control by continuous spraying. Cook of New Jersey states that spraying with Bordeaux mixture 5-6-50 was effective. Thurston and Orton report good control in Luzerne County, Pennsylvania by spraying. Adams of Delaware states that Bordeaux dust and liquid Bordeaux have proved equally successful in the control of late blight in demonstration work. Coons reports spraying at Portage and at Muskegon, Michigan, using Bordeaux mixture, entirely successful.

The following special reports on the results of spraying and dusting for the control of this disease are of interest:

New York: Celery blights were less destructive than usual, because of extremely dry weather. The following are some of the results of the control of blight through spraying and dusting.

The average of a total of six experiments over a period of three years showed after five applications of 5-5-50 Bordeaux mixture that the average check has 1079 blight spots per plant ranging from a minimum in any experiment of 507 spots per plant to a maximum of 1733. Sprayed plants showed 63 blight spots per plant on the average and the minimum was 35, while the maximum number of spots was 126.

Power spray and dust plots this season showed the following differences: Six applications of 5-5-50 Bordeaux gave a reduction in blight of 91%, while the six applications of equivalent amounts of 15-85 copper lime dust (containing 15% monohydrous copper sulphate and 85% lime) gave a reduction of 95% in the development of blight. The spray gave an increase of 46 two-thirds size crates per acre, while the dust applications gave an increase of 70 of these crates per acre. (H. W. Dye, January 28, 1922. See also Dye, H. W. and A. G. Newhall, l. c. under bacterial leaf spot).

Ontario: We have been using for the past two years a dust made up of 20% Bordeaux, 20% sulphur, 30% lime, and 30% tobacco dust. We use the combination of sulphur and Bordeaux for two reasons; one that it seems as if the sulphur made the Bordeaux stick better and also seemed to aid in controlling the late blight. The tobacco dust was added to get control of the tarnished plant bug which has caused us a great deal of loss through the disease locally called celery heart rot; this disease is secondary. We found during the past two years that the tobacco dust was much more satisfactory in warding off this insect than the "Black Leaf 40" because it holds its odor much longer. It is necessary to dust each week; where this is carried on thoroughly we found we had no difficulty in controlling both the disease and the tarnished plant bug. (A. H. MacLennan, Vegetable Specialist, Department of Agriculture, Ontario).

Recent literature

Laibach, Friedrich. Untersuchungen über einige Septoria-arten und ihre Fahigkeit zur Bildung höherer Fruchtformen III und IV. Zeitschr. Pflanzenkr. 31: 161-194. 1921.

Early blight caused by Cercospora apii Fries

Early blight of celery was reported from Vermont, Rhode Island, Connecticut, New York, Pennsylvania, South Carolina, Ohio, North Dakota, Colorado, and California as being either unimportant or of about the same prevalence as last year, while in New Jersey, Delaware, West Virginia, Florida, and Indiana it was said to be abundant and causing heavy losses. In Indiana, according to Gardner, it was probably the worst disease of the crop.

Bacterial leaf spot caused by Bacterium apii Jagger

This disease, first mentioned by Jagger some years ago in a short note, was described by him during 1921 as due to a new bacterium. The distribution, as given by records available to Jagger, was New York and Michigan, but doubtless the disease is present throughout the northeastern celery growing district. It is reported in 1921 as being of about the normal prevalence in New York, reducing the yield 2 to 5%. Newhall reports green stem types less affected than Easy Blanching. The disease is reported as doing perhaps more than the usual amount of injury in Michigan. Interesting results in the matter of control with the use of equivalent amounts of 5-5-50 Bordeaux mixture and 15-85 copper lime dust were reported by Dye and Newhall[1]: "Almost complete reduction of blight development was obtained. The spray and dust appeared to be equally effective in controlling these blights, and both gave similar increases in yields over the checks." (See also the special report by Dye on spraying and dusting celery under late blight).

Literature cited

1. Dye, H. W. and A. G. Newhall. Spraying and dusting for the bacterial and late blights of celery in western New York. (Abstracts) Phytopath. 12: 48. 1922.
2. Jagger, Ivan C. Bacterial leaf spot disease of celery. Jour. Agr. Res. 21: 185-188. 1921.

Other diseases

Bacterial soft rot caused by Bacillus carotovorus Jones - New Jersey (root rot, very destructive, especially on muck soils. Poole, R. F. Celery disease investigations. Rep. Dept. Plant Path. New Jersey Agr. Col. Exp. Sta. 1919-20. 608-609), Pennsylvania, and Ohio.

Black heart, cause unknown, caused heavy loss at Sanford, Florida. (Jagger, March 9, News Letter, Office of Cotton, Truck, and Forage Crop Disease Investigations, May 7).

Watery soft rot caused by Sclerotinia libertiana Fckl. was locally severe in New York, New Jersey, Florida, and California, causing field and storage rot in New York; damping-off in greenhouse seedbeds in New Jersey; foot rot in Florida (Jagger); and in Los Angeles, Orange, and Santa Cruz Counties, California, reducing the yield 3%.

Rhizoctonia rot - Connecticut (fruiting at base of stalks), New York (stalk discoloration), Ohio (root rot and general decay in the trenches).

Damping-off - Connecticut (Pythium debaryanum Hesse), California (Fusarium sp.; about 5% loss in the El Monte district - Milbrath).

Root rot, cause unknown, was observed in Erie County, New York, August 23.

Suspected mosaic was reported from Indiana on Golden Self-blanching.

Root knot caused by Heterodera radicicola (Greef) Müll. was reported from South Carolina and Indiana.

Crinkle, cause unknown, was of slight importance in Connecticut.

Hollow stem was common throughout the state of California, causing stalks to collapse and decay rapidly. (Milbrath).

Annualism, "Seeders", was very prevalent in western Washington.

EGGPLANT

Fruit rot caused by Phomopsis vexans (Sacc. and Syd.) Harter - severe in New York (5% loss), New Jersey, Maryland (5% loss), Virginia (50% loss at Truck Station, Norfolk), West Virginia (5% loss), Tennessee (common), Illinois (most serious disease of eggplant), and Michigan (100% loss in some fields, but negligible because of no market for eggplants). One report was received in Ohio, and Iowa reported it as less prevalent than last year. The high losses in the northern states doubtless were related to the high temperature.

Market inspectors reported fruit rot as causing an average of 22% loss in ten cars of Florida eggplants and 5% in one car from Texas.

A leaf spot caused by Alternaria sp. was general but slight in West Virginia.

Mosaic - (See Melhus, I. E. Mosaic studies. (Abstract) Phytopath. 12: 42. Jan. 1922).

Bacterial wilt caused by Bacterium solanacearum EFS was reported from Pennsylvania and Virginia. At Freeland, Pennsylvania Weiss reported it as causing 100% infection and serious injury on Chinese white eggplant. In Virginia it first appeared July 25 at Oceana where it was very severe in a home garden.

Wilt caused by Verticillium albo-atrum Reinke and Berth. was reported by Cook as being abundant in New Jersey.

Wilt caused by Fusarium sp. (?) was reported as first appearing September 8 in Westchester County, New York.

Rhizoctonia sp. was reported from Freeland, Pennsylvania by Weiss.

Wilt of unknown cause (a Sclerotium isolated) was reported by Gardner as being the worst disease of the crop in Indiana, causing premature death of the plants.

Damping-off caused by Pythium debaryanum Hesse and Rhizoctonia sp. was reported by Clinton as occurring in seedbeds at Highwood, Connecticut April 11, and at Westville April 13.

Stem rot and blight caused by Nectria sp. (See Ishikawa, Takitaro. Nosu to Sekkwai Iwô Gôzai. (Lime sulphur and eggplant). Jour. Plant Prot. 8: 177-185. April 21).

Rot caused by Phytophthora sp. occurred in one garden in Lafayette, Indiana in September; probably spread from tomatoes to eggplant. Artificial inoculation successful. (Kendrick). (See also Haskell, R. J. Phytophthora infestans on eggplant in the United States. Phytopath. 11: 504-505. 1921).

Nematode, presumably Heterodera radicicola (Greef) Müll. was extremely severe at Freeland, Pennsylvania, according to Weiss.

Storm injury. Burger reports a hard wind storm (October 23-25) in Florida which did considerable damage to the crops of the state, and caused almost total loss to eggplants in Manatee County.

ENDIVE

Damping-off caused by Rhizoctonia solani Kühn was slight in seedbeds at Westville, Connecticut, April 13.

Root rot caused by Pythium debaryanum Hesse was slight in greenhouses at New Haven, Connecticut, June 17.

GINSENG

Root rot caused by Phytophthora cactorum (Leb. and Cohn) Schröt. - Connecticut (rot of the roots and stem; first appeared June 24 at Winsted; first report for state).

A root rot, cause undetermined, - Washington.

Blight caused by Alternaria panax Whetzel - Michigan.

Moldy seed caused by Botrytis sp. - Washington.

Reference: Stockberger, W. W. Ginseng culture. U. S. Dept. Agr. Farmers' Bul. 184. April 1921.

LETTUCE

Drop, caused by Sclerotinia libertiana Fckl. or S. minor Jagger was reported as common in many states, with occasional reports made of some loss occurring locally. The following states reported the disease: Connecticut (at Ellington, October 3), New York (1 to 3% loss), New Jersey (common), Pennsylvania (40% loss in one greenhouse, 10% loss in one field), Maryland (trace), North Carolina (less), South Carolina (little damage in fields - Jagger), Texas (unimportant), Ohio (moderate loss), Minnesota (serious where rotation is not practiced, but less in 1921 because of heat destroying the crop - Leach), California (3% loss, found in Los Angeles, Santa Cruz, and Orange Counties).

Gray mold rot caused by Botrytis cinerea Pers. - slight damage in Connecticut, New York, Maryland, Ohio, Indiana, and Iowa.

Downy mildew caused by Bremia lactucae Regel - unimportant in New York, Texas, Washington; locally serious in Indiana (greenhouse), Iowa, Kansas (caused about 75% loss of seedlings in propagating houses of one grower); very important in California (reducing yield 5%; found in southern California, except Imperial Valley).

Recent literature

Erwin, A. T. Control of downy mildew of lettuce. Proc. Amer. Soc. Hort. Sci. 17 (1920): 161-168. 1921.

___________ Controlling downy mildew of lettuce. Iowa Agr. Exp. Sta. Bul. 196: 307-328. Illus. Jan. 1921.

Link, Geo. K. K. Downy mildew; a transit disease of lettuce. (Abstract) Phytopath. 12: 48-49. Jan. 1922.

Anthracnose caused by Marssonia panattoniana (Berl.) Magnus - Kansas (33% loss at Hutchinson), Washington (Whitman County).

Leaf spot caused by Septoria lactucae Pers. - Delaware.

Mosaic, which has recently been described by Jagger (Jagger, I. C. A transmissible mosaic disease of lettuce. Jour. Agr. Res. 20: 737-739. 1921), was reported by Newhall and Dye as being unusually prevalent in New York, where it caused from 8 to 10% loss in the largest lettuce growing sections.

Jagger (News Notes, Office of Cotton, Truck, and Forage Crop Disease Investigations, May 7) reported mosaic as less destructive than it was two years ago in the Beaufort, South Carolina lettuce district. Occasional plants were found affected, and in a few cases 25% or more showed mosaic, but in general the loss was slight. Jagger (l. c., Mar. 2) also reported mosaic as an important factor in the failure of lettuce crops at Sanford, Florida, during January and February.

Tipburn (non-parasitic) - New York (very important, reducing the yield 15 to 18% and affecting the first crop from the middle of June to the middle of July), Texas (prevalent; 2% loss), Idaho (considerable loss in the Lewiston district, probably due to the hot dry weather conditions).

Bacterial soft rot (species undetermined) - Many collaborators report soft rots of lettuce in both field and greenhouse, causing decay of heads. In some cases this is a bacterial rot following tipburn or lesions produced by other causes. This condition was reported in 1921 from South Carolina (under the name of "black heart" - Jagger, l. c., May 7. See mosaic), Michigan (100% loss in some fields), Minnesota (injury to small plants following tipburn), Colorado (important locally), Arizona (Casa Grande district and Rillito Valley; on Boston Market following February frosts, some fields reported as entirely ruined).

Black heart (cause unknown), which produced an internal decay of the heads, was reported from the Imperial Valley, California as being more severe than previously, causing 6% loss.

"White heart" was very severe this year in New York. In past seasons this disease was not at all serious, and only an occasional heart affected with this trouble would be seen as one passed through a field. This year 8% occurred throughout the season, and during the latter part from 25 to 65% of the heads in all fields were made unmarketable. (H. W. Dye, Jan. 28, 1922).

Decay due to Alternaria sp. - King County, Washington.

Rhizoctonia rot - This disease, first described in literature under the name of black root, and also called bottom rot, black bottom, rosette, and stem rot, is reported in 1921 from New York as attacking the late crop and reducing the yield from 8 to 12%; from Pennsylvania as causing 20% loss in one field, being worse on Big Boston than on other varieties; and in the rosette form from Ohio and Indiana.

Dye, H. W. The bottom-rot disease of western New York lettuce.
(Abstract) Phytopath. 12: 48. Jan. 1922.

Damping-off, caused by Pythium debaryanum Hesse - occurred in Connecticut. Clinton also reports the isolation of another Pythium with a spiny oogonium, which may itself be injurious, or merely following P. debaryanum.

Pythium root rot (species not determined) - Michigan (on both field and greenhouse lettuce; 5 to 10% loss caused in some greenhouses).

Root rot caused by Fusarium sp. was reported as the limiting factor in the production of high grade lettuce in Kentucky. It caused a reduction in yield for the state of 60%. The plants fail to head properly after they have made a good start. High temperatures favor rapid development of rot, and the disease caused greatest injury in late spring, both in the field and in greenhouses.

Root knot caused by Heterodera radicicola (Greef) Müll. - unimportant in South Carolina and Ohio.

Dodder (Cuscuta sp.) - Missouri.

MANGEL-WURZEL

Rhizoctonia sp. - Washington.

OKRA

Root knot caused by Heterodera radicicola (Greef) Müll. - Texas, 2% reduction in yield.

Root rot caused by Ozonium omnivorum Shear was very prevalent in Texas, causing a 20% reduction in yield.

Wilt caused by Fusarium vasinfectum Atk. - 1% loss in Texas.

Macrosporium hybiscinum Thüm. - Clark County, Ohio, September 23.

PARSNIP

Leaf spot caused by Cercosporella pastinacae Karst. - Indiana (considerable importance in market gardens, causing a mottling of the leaves; first seen September 7 in Marion County).

Common scab caused by Actinomyces scabies (Thaxter) Güss. A specimen was sent in to the laboratory at Cornell from Madison County, New York, March 24.

PEA

Root rots caused by various organisms

"A survey of Montana, Idaho, and Utah indicates that there are incipient cases of pea root-rot in nearly all the important districts and that under present conditions it will be only a matter of time before this type of trouble is as widespread as it is in the East..... The western climate cannot be depended upon to keep plants healthy. Growers should therefore watch carefully for the appearance of pea root-rots and practice the longest possible rotation to prevent its development. The situation is not one to justify undue alarm, but these findings should te taken seriously if the interests of the pea crop in later years are to be safeguarded." (U. S. Dept. Agr. Weekly News Letter, Nov. 9, 1921).

It was estimated by F. R. Jones that the pea crop in Morgan Valley, Utah was reduced 10% by root rot, individual fields showing losses of 25 to 30%. Milbrath reports the losses from this cause heavy in San Diego, Orange, and Los Angeles Counties, California, where high temperatures prevailed. The reduction in yield for the state was estimated at 15%. F. R. Jones also reports root rot as unusually destructive in the Baltimore trucking district of Maryland, due to unfavorable weather.

Root rot associated with Fusarium sp. - New York (serious in Suffolk County), New Jersey (serious in southern part of state), Delaware (very important), Maryland (severe on infested soils, becoming more prevalent), Wisconsin, and Montana (found in Gallatin, Paradise, and Montana Valleys in July).

Root rot associated with a Pythium first appeared at Highwood, Connecticut, May 26. In Delaware it caused severe loss in fields which have been cropped for a number of years to peas. It was the limiting factor in some fields in Wisconsin, but the loss was difficult to estimate because of very hot, dry weather. It was found in the Gallatin and Paradise Valleys, Montana, in July, occurring generally in pea-growing sections, especially in fields where peas have been grown for many years.

Rhizoctonia root rot was reported from Wisconsin as prevalent in the older pea-growing sections. Early and canning peas were affected in the vicinity of Greeley, Colorado.

Other diseases

Bacterial blight caused by Pseudomonas pisi Sackett - Delaware (very important), Maryland (damaged by blight on Eastern Shore where exposed to early freezes), Indiana (noted May 20 in one field in Marion County), North Dakota (slight), Montana (unimportant), and Colorado (not serious).

Blight caused by Ascochyta pisi Lib. - severe in Delaware, Maryland, and California; unimportant in New York, New Jersey, and Wisconsin; not seen in Virginia, Ohio, Montana, and Colorado.

Downy mildew caused by Peronospora viciae Berk. - of minor importance in Delaware, Tennessee, and Wisconsin.

Powdery mildew caused by Erysiphe communis Fr. - New York (important in one field in Allegany County), Colorado (present at Fort Collins in July), Idaho (common in late garden peas), Washington, and California (very severe in Riverside and San Diego Counties, destroying whole fields in Riverside County, and causing a 2% reduction in yield for the state).

Septoria blight caused by Septoria pisi West. was reported as being unimportant in New Jersey, Wisconsin, Montana, and Colorado. Adams reports it as much more prevalent than last year in Delaware, especially on plants weakened by the late frosts in the spring. First observed May 21 at Georgetown.

Anthracnose caused by Colletotrichum pisi Pat. (See Vaughan, R. E. and Fred R. Jones. Colletotrichum pisi Pat. on garden peas. (Abstract) Phytopath. 12: 1922., also Hemmi, Takewo. Endô no tansobyô (Anthracnose of pea). Jour. Plant Prot. 8: 229-233. May 1921).

Spot caused by Mycosphaerella pinodes Berk. and Blox. - Wisconsin.

Mosaic. "Green peas were also affected by mosaic and mottling was observed on the flowers of purple varieties." (Dickson, B. T. Maladies des plantes en 1920-21. Ann. Rep. Quebec Soc. Prot. Plants 13 (1920-21): 66-67. 1921).

Dodder (Cuscuta sp.) - one report from Missouri.

Blasting due to hot weather caused almost 100% loss in Michigan.

PEANUT

Leaf spot caused by Cercospora personata B. & C. was reported from West Virginia, North Carolina, South Carolina, Florida, Alabama, and Arkansas as comparatively unimportant, although some collaborators report the disease as general and causing rather serious defoliation. The following publication is worthy of record: Bal, S. N. Commentationes mycologiae 8-10. Jour. Dept. Sci. Uni. Calcutta 3 (Bot.) 8 p. pl. 1921.

Wilt or blight caused by Bacterium solanacearum EFS - more prevalent than usual in North Carolina.

Rust caused by Puccinia arachidis Lag. had already been found in Florida before the publication by J. C. Arthur of a note concerning its probable seriousness if introduced into the United States (Two destructive rusts ready to invade the United States. Science n. s. 51: 246-247. March 5, 1920). It was discovered by C. D. Sherbakoff in a field on the farm of the experiment station at Gainesville, August 30, 1918, and was apparently of no importance. O. F. Burger reported the collection of the disease in November 1920 at Torrey Island, Florida, where it was said to be causing 50% loss in a 15 acre field, but not to occur in other fields. (See Pl. Dis. Bul. 5: 51-52, 88.1921).

Tipburn, of which leaf-hoppers were the suspected cause, was reported from South Carolina.

Ozonium root rot, caused by *Ozonium omnivorum* Shear - was prevalent on black lands in Texas, causing 10% loss.

Sclerotial blight caused by *Sclerotium rolfsii* Sacc. was prevalent on light sandy soils in Texas (loss 1%); slight in Alabama; important in North Carolina (1% loss).

Chlorosis due to excess of lime in the soil caused .5% loss in Texas.

PEPPER

Mosaic, cause unknown, - vicinity of Chattanooga, Tennessee (affecting about 10% of the plants of Giant King and a few plants in a field of Ruby King - Sherbakoff. See also potato), New Jersey (common, in some cases causing heavy loss), Pennsylvania, Indiana (considerable damage), and California (.5% loss, affecting the winter crop in Orange and San Diego Counties - Milbrath).

Anthracnose caused by *Colletotrichum nigrum* E. & H. - 1% loss in West Virginia.

Leaf blight caused by *Cercospora* sp. - Palmetto, Florida. (Jagger).

Bacterial spot (*Bacterium vesicatorium* Doidge). Sherbakoff reports the "bacterial warty leaf spot" reported from Texas by Heald and Wolf and by himself from Florida as causing slight damage in Tennessee in 1921. Gardner reports the production of typical lesions on pepper with pure cultures from tomato. For discussion of probable relationships see Gardner, Max W. and James B. Kendrick. Bacterial spot of tomato. Jour. Agr. Res. 21: 123-156. April 15, 1921. (Cf. also Takimoto, Seitô. Tôgarashi no saikinbyô (A bacterial disease of red pepper). Byochu-gai Zasshi (Jour. Plant Prot. 8: 510-511. 1921).

Sclerotium blight, (*Sclerotium rolfsii* Sacc.) was locally severe in South Carolina.

Root rot and *wilt*, caused by *Fusarium* sp. The former trouble was reported as doing 1% damage at Chattanooga, Tennessee (Sherbakoff); and wilt on pimentos was reported from Orange County, California, doing 5% damage. (Milbrath).

Macrosporium fruit rot - Arizona (50% damage in one field).

Damping-off due to *Rhizoctonia* sp., *Botrytis* sp., and *Sclerotinia libertiana* Fckl. was serious in Connecticut.

Rhizoctonia rot - New Jersey (serious in a few cases), Pennsylvania.

Bacterial wilt, caused by *Bacterium solanacearum* EFS - Pennsylvania (on long red cayenne pepper at Freeland - Weiss), Texas (Kinney County).

Nematode injury, *Heterodera radicicola* (Greef) Müll., was common on eggplant and peppers, Freeland, Pennsylvania. (Weiss).

Leaf fall, cause unknown, was serious in some cases in New Jersey.

Sunscald did considerable damage in Indiana.

RHUBARB

Crown and stalk rot, caused by Phytophthora sp., was reported from Pennsylvania as first appearing August 13 in Philadelphia County, causing 20% damage in one field. A rot similar as far as aspect is concerned is described by Sherbakoff, but is tentatively attributed by him to Phytophthora terrestris. He makes the following statement concerning the disease in Tennessee;

> "Phytophthora rot, closely associated in place and etiology, in the field with buckeye rot of tomatoes, had been observed in a few fields, in one case killing about 75% of the plants. The evidence at hand indicates that the disease is very common in the state, especially in the western part. I believe that the disease is the chief factor of failure of rhubarb culture in the entire southeast, undoubtedly so in Florida and Tennessee." (See also Pl. Dis. Bul. 5: 102. Sept. 15, 1921).

Antaracnose caused by Colletotrichum erumpens Sacc. - very severe in Barbour County, West Virginia in September.

Leaf spot caused by Phyllosticta sp. - Center County, Pennsylvania.

Leaf spot caused by Ascochyta rhei Ell. & Ev. - of considerable importance at Indianapolis, first appearing May 20 on leaf and petiole.

SALSIFY

White rust caused by Albugo tragopogonis Pers. - New York (very common), Kansas (at Sedgwick).

Rust caused by Puccinia tragopogi (Pers.) Cda. - Idaho.

Powdery mildew was found in Doniphan County, Kansas, August 8.

SPINACH

Downy mildew caused by Peronospora effusa Rabenh. was reported as serious in Indiana greenhouses in March; as very prevalent in Texas, causing 15% reduction in yield; as very severe in Imperial, Los Angeles, and Sacramento Counties, California, causing 100% infection in the Imperial Valley and a 15% reduction in yield for the state. Milbrath reports as follows on May 4:

> "During the season of 1920-21 there were about 800 acres of spinach in the Imperial Valley. On December 30, about 50% of the acreage had been plowed under on account of mildew. I found the disease in all fields to an extent of 50% severe infection. Owing to the disease and poor market, shipments were few, and a small outlet was found through a cannery in San Diego. Today's report shows a total of 36 cars shipped from the whole state during the season, in contrast with 275 cars last season. Of the 36 cars I know of, 12 were shipped from the Valley, where 300 were expected."

Anthracnose caused by Colletotrichum spinaciae E. & H. - unimportant in Texas.

Rust caused by *Uromyces fabae* (Pers.) DeBy. - was reported by Fields as present in Alameda County, California, and probably in San Mateo County also.

Leaf rust caused by *Puccinia subnitens* Diet. - Clemenceau, Arizona.

Mosaic (cause unknown) - unimportant in Indiana, locally important in Illinois, first report of the disease; 100% in one field in Minnesota; severe in California, controlling factor in the El Monte district. (See also Smith, Loren B. Notes on spinach breeding. Amer. Hort. Soc. Proc. 17: 146-155, and Smith, L. B. Breeding mosaic resistant spinach and notes on malnutrition. Virginia Truck Exp. Sta. Bul. 31/32: 137-160. Ap./Je. 1920 (1921)).

Crown rot caused by *Phytophthora* sp. - Indiana (destroyed 50% of the plants in one patch at Lafayette, under Skinner irrigation; first noted June 21; high temperatures probably favored the fungus).

Wilt caused by *Fusarium* sp. - Idaho (of no great importance, found in the Lewiston district).

Damping-off caused by *Pythium debaryanum* Hesse was causing slight injury to young seedlings in the field at Highwood, Connecticut, April 11.

Root knot caused by *Heterodera radicicola* (Greef) Müll. - Elkhart County, Indiana, September 9.

Malnutrition (See Smith, L. B. l. c. under mosaic).

Annualism (running to seed) - western Washington (very prevalent; probably due to nutritional and climatic conditions - Frank).

SWISS CHARD

Leaf spot caused by *Cercospora beticola* Sacc. - unimportant in West Virginia, Texas, and Colorado.

Rust caused by *Uromyces betae* (Pers.) Lev. - South San Francisco and Colma districts, California (W. S. Fields).